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ENCINEERING NEWS.

THE Am. Soc. C. E. Nominating Committee has chosen the following candidates for officers for the ensuing year: President, WILLIAM P. SHINN; Vice-Presidents, ALPHONSE FTELEY, of New York, MENDES COHEN, of Baltimore; Secretary, JOHN BOGART; Treasurer, G. S. GREENE, Jr.; for Directors, Prof. CHARLES B. BRUSH and THEODORE VOORHEES, of New York; ROBERT VAN BUREN, of Brooklyn; Maj. WILLIAM LUDLOW, U. S. A., and WILLIAM G. CURTIS, of San Francisco.

ON the current "Blue List" of the American Society of Civil Engineers there are two "reconsiderations of proposals," meaning reballots of candidates once rejected by the constitutional five negative notes, showing how necessary was the provision giving candidates a right to demand an open ballot. Both the "reconsiderations" appear to be for well-qualified candidates.

A NATURAL GAS ORDINANCE has been passed by the City Council of Cincinnati, Ohio, and approved by the Mayor and Board of Public Affairs, and is now a law. The ordinance regulates the introduction of natural gas from the Indiana field, and fixes the price at 15 cts. per 1,000 cu. ft. for the first five years. A pending ordinance proposes to bring gas from the Ohio gas field.

COL. JAMES ANDREWS, of the Tehuantepec Ship Railway, is responsible for the following choice bit of evidence as to the engineering work on the Panama Canal, which we take from a newspaper interview.

"The Panama Canal project is not dead by any means," said Mr. ANDREWS. "When in Paris this summer I paid a visit to M. BRUNOT, the receiver of the bankrupt company. He has, after paying all the debts, about $2,800,000 left in the treasury. He has decided to send out a commission of engineers to Panama during the winter. They will make as accurate a survey as possible to determine the amount of money necessary to finish the canal. *This, M. Brunot informed me, will be the first trustworthy survey since the work was begun.*

The italicized sentence is undoubtedly true to the facts, but it is an amazingly frank confession.

THE ROUTE FOR THE PANAMA CANAL is to be accurately surveyed by a special commission during the coming winter, says M. BRUNOT, the receiver of the bankrupt company. And M. BRUNOT further adds that this will be the *first reliable* survey since the work was commenced. This is rather a severe commentary on French methods of canal digging, but agrees with previous reports from more than one of their own engineers. With thorough surveys and reliable estimates to start with, the probability is that Frenchmen would have saved millions of money—by letting the canal alone—and DE LESSEPS would not have been deceived into starting a work of unknown dimensions and cost.

THE INTERNATIONAL MARITIME EXHIBITION at Boston will open Nov. 4, and continue open till Jan. 4, or 62 days. It promises to be a very successful affair. The building has seven acres of floor space in an average of about three stories, and costs somewhat over $500,000 or some $70,000 per acre. At this rate a 100 acre building for a world's exposition would cost $7,000,000, which would be cheap enough, but so much larger a building should be still cheaper. We understand the Maritime Exhibition is likely to be a very full and successful one.

THE GERMAN ADMIRALTY reckons upon having 165 torpedo boats next year. The German navy already possesses nearly 90 such vessels, most of them built at Stettin, and it is intended to build 15 new ones at once of 75 tons burden, while the rest, of various sizes, are to follow. Most of the German torpedo boats are of 20 tons greater burden than the French vessels employed for that purpose, and can be used, if necessary, in the open sea.

SIX YARROW TORPEDO BOATS, of the first class, have on a recent trial a mean speed of 22½ and 23 knots in a three hours' run. The fastest mean speed was 23.032 knots for three hours. All of the boats are of the same size: Length, 130 ft.; beam, 13 ft. 6 in. About 1,140 horse-power is claimed to have been developed in each case, with an actual load of 20 tons carried. The engines are triple-expansion; the fire-box has an air-tight casing, which prevents flooding with water; the air necessary for draught passes over its casing. The boilers are of the locomotive type. Each boat is armed with three 3-pounder rapid-fire guns and one fixed torpedo tube in the stern and two swivel tubes on a platform on deck. The hulls are made of galvanized iron.

RAILWAY GROSS EARNINGS during the first nine months of 1888 are reported to *Bradstreet's* for 124 railway companies operating a total of 74,104 miles of road. The total gross earnings are $247,022,710, an increase of 8.9 per cent. over 1888. The earnings of the companies in different sections of the country are shown in the following table:

	1889		1888	
	Earnings.	Mileage.	Earnings.	Mileage.
10 Granger roads ...	$35,259,941	12,485	$34,006,964	12,052
44 Central Western roads	47,975,011	13,139	44,944,465	12,945
8 Eastern roads ...	9,625,268	1,918	9,221,184	1,784
3 Trunk line roads	17,752,784	4,011	16,464,124	3,943
36 Southern "	51,437,979	13,365	46,178,920	13,015
15 Southwestern "	42,973,119	15,432	39,770,908	15,177
6 Pacific "	34,731,702	10,028	30,177,350	10,582
2 Mexican "	7,267,806	2,745	6,979,856	2,262
Total..	247,022,710	74,104	226,743,268	71,715

It will be seen that the Southern, Southwestern, and Central Western roads have made the chief gains, while the roads of other sections have made comparatively slight advance.

For the month of September alone, the earnings of 128 companies were $32,568,456, an increase of 11.6 per cent. over the earnings of the same companies in September, 1888. On the whole, there is every prospect that this year will prove a very satisfactory one to railway stockholders.

SEVERAL SERIOUS RAILWAY ACCIDENTS have occurred during the past week, the worst one, on the whole, being a rear collision on the Burlington & Missouri River Railroad at Gibson, near Omaha, Neb., on Oct. 15. The collision occurred at a level crossing, the locomotive of one train striking a chair car and combination car on the other train and completely wrecking them. Fifty passengers are reported injured, two or three fatally. Fire broke out in the wrecked car, but was extinguished.

A SERIOUS DERAILMENT occurred Oct. 12, as a fast express on the Philadelphia, Wilmington & Baltimore Railway was running at nearly 60 miles an hour, near Northeast, Ind. An extra freight ahead lost an iron door, which fell on the track at a curve where the engineer could not see it in time to apply the brakes. About 19 persons received serious injuries. Fire broke out at this wreck also, but was extinguished by the baggage-man before it gained headway.—Another derailment occurred Oct. 13, at Rahway, N. J., on the Pennsylvania Railroad, this accident also occurring to an express. The track was badly torn up, but nobody was seriously injured. It is reported that some of the rails had just been laid, and were not spiked securely.—Near Madden Station on the Texas & Pacific, a freight train ran into a washout on Oct. 15, and the engineer, fireman, and brakeman were killed.

A BAD ACCIDENT occurred Oct. 15, on the Mt. Auburn Incline Cable Railway in Cincinnati. The ascending car reached the top of the grade, and should have stopped; but when the engineer tried to close the throttle of the engine which drove the cable, some part of the machinery was deranged, and the engine kept on its motion. The car was drawn against the stop block, the cable was pulled from its fastenings, and the car, with the passengers locked inside, started down the slope. It was running at a terrific speed when it reached the bottom, and the wreck which ensued was complete. Of the 9 passengers, 5 were killed and the others were badly injured.

Overwinding has been a common enough cause of mine accidents, but has not been thought a danger on cable inclines. It seems probable that the car must have been wholly unprovided with brakes, or it could not have attained such a great velocity on the incline. On steep inclines, of course, a brake would not stop the car; but it would so retard its motion as to prevent any great velocity being attained. All elevators built by reputable makers are now provided with safety clutches, which act in case the pull on the rope ceases; and it seems that the same principle might be utilized on steep inclined railways.

THE BRIDGE across the Sapulpa River, at McNeill, Ala., was burned Oct. 5.

MASTER CAR BUILDER ROBERT MILLER, of the Michigan Central, states that the private car of President LEDYARD, which stood the rear collision at Palatine Bridge with so little damage, was no stronger than any of the passenger coaches which are now built in the company's shops. He claims that the strength of the car was chiefly due to the avoidance of mortises in the end sill and the use of oak plank for the sides of the car from the window sill down.

A FAST MAIL TRAIN over the Canadian Pacific is to be put on to carry the through Asiatic mail across the continent from St. John, N. B., to Vancouver, B. C., according to press dispatches. The run is to be made in 4 days, which will give an average speed, including stops, of about 35 miles per hour. The train will carry no passengers, and each locomotive will have a run of about 250 miles. Some special locomotives for the service are now being built, with tenders of double the usual capacity.

THE FORTH BRIDGE is being rapidly completed, and the *Scotsman* says that workmen have already crossed from one side to the other on ladders and planks. The practical completion of the bridge is looked for some time towards the end of this month.

THE WESTERN UNION TELEGRAPH CO., says the Philadelphia *Press*, has perfected arrangements for burying its wires in the heart of that city, using the conduits of the Bell telephone system, now down, for part of the system. A year at least will elapse before the poles can be removed in that section where the change is to be made.

THE WESTINGHOUSE ELECTRIC LIGHT CO., according to an interview with Mr. GEORGE WESTINGHOUSE, Jr., is by the decision of Judge BRADLEY left just where it was before the suit, in an unassailable position as far as its rights are concerned. The company will still make and sell incandescent lights, and its customers can use them as freely as before. If the decision is affirmed by the Supreme Court, the Edison Co. will destroy the Mann-Sawyer patent on fibrous carbon filaments, but it will have no patent itself, and will still have to face the patents of WESTINGHOUSE on other features of the lamp. The ultimate effect will be to make the incandescent lamp public property and greatly increase the demand.

THE THOMSON-HOUSTON ELECTRIC Co., on Oct. 5, increased its capital stock to $4,500,000, by an addition of $1,500,000. This new stock is to be sold to hareholders pro rata.

THE NEW CROTON AQUEDUCT CONTRACTORS, Brown, Howard & Co., have filed a claim against the city for $768,110.76 for extra allowances on their work, now accepted. The contractors charge $25,000 on account of alleged errors in the engineer's estimates; $50,000 for expense on behalf of the investigating committee; $102,350 for grouting not called for in the contract; $44,442 for extraordinary changes in the plans; $30,000 for tunnel excavation under Gould's swamp; and $50,000 for extra masonry. The remainder is made up of various other items. Rogers, Shanly & Co. have filed a similar claim for $250,000 on Sections 13 and 14.

GRAPHITE is suggested by the Los Angeles papers as a proper ingredient to mix with the cement now being used for laying miles of cement sidewalks in that city. These walks are objectionable only for the blinding glare of the white material used, and the plumbago, which exists in quantities in that neighborhood, is recommended as a means of producing a color more grateful to the eye.

PRACTICAL SANITATION is to be the subject of a course of lectures this writer by Mr. R. P. FLEMING at the McGill University, Montreal. This is the latest innovation of Prof. BOVEY, the Dean of the Faculty, in increasing the efficiency of the science courses of that institution.

THE ALBANY ASSEMBLY CEILING SCANDAL has resulted in an action commenced by Attorney-General TABOR against the contractor, JOHN SNAITH, to recover $250,563. The action charges fraud and conspiracy—in procuring the passage of the ceiling law; in procuring the letting of the contract to SNAITH; in falsifying estimates; and in illegal conversion of the materials in the old ceiling to personal use.

THE PLAN FOR REORGANIZING ATCHISON, TOPEKA & SANTA FE financial affairs has at last been made public. The proposition is to issue $150,000,000 of 4 per cent. 100 year general mortgage bonds, and $80,000,000 of 5 per cent. non-cumulative income bonds. The latter class of securities is for the purpose of providing for such reductions of interest upon present bonds as may be found necessary to bring the fixed charges of the company within its earning power. The company's immediate cash requirements are set at $10,000,000; and the Board of Directors state in the plainest possible terms to the security holders that if the proposals for reorganization fails of acceptance, a foreclosure and receivership will be inevitable.

The statement of the company's earnings for August shows gross earnings of $2,402,451, an increase of $98,613 over the same month last year. From Jan. 1 to Sept. 1 gross earning were $16,973,384, an increase of $350,267 over the same period last year.

THE DYNAMITE BOAT "VESUVIUS," in her last test of Oct. 9, fulfilled every contract requirement. She fired fifteen shots in sixteen minutes, and it is proven that the three guns of the *Vesuvius* can throw 1,500 lbs. of dynamite per minute. The range exceeded the contract mile by 100 to 350 yds., and a pressure of 750 lbs. per sq. in., instead of 1,000 lbs., was found sufficient to fire a telling shot of 15 ins. diameter weighing 527 lbs. The mean speed of the the cruiser on the speed test was 21.6 knots.

THE HUDSON BAY RAILWAY SCHEME has been revived again, this time in the shape of a proposed line from Sault Ste. Marie to Moose Factory, near the southern extremity of James Bay. Great stories are told of the timber and mineral wealth which the new line will make accessible along the Moose River. If the projectors of the railway can secure local traffic enough to support their road, the scheme may be sound enough; but it should be plainly understood that to make Hudson Bay the route for grain exports of any amount is a hopeless task. Navigation in the Arctic regions is practicable if it will pay; but the route via the Great Lakes is so easy and cheap a one to the seaboard that the profits from the somewhat shorter route via Hudson Bay would not be enough to compensate for the increased risk.

The "Lortzing" System of Sewage Purification.

The following system of purifying the water carried sewage of towns, and other waste waters, is the invention of Mr. C. LORTZING, of 10 Birkenstrasse, Berlin. It is claimed for this apparatus and process that it combines the following advantages: (1) The mechanical and chemical treatments are strictly separated, all impurities capable of mechanical elimination being removed before the chemicals are introduced. (2) By thus reducing the quantity of chemicals, the cost is saved and the quantity of final product is reduced, again saving money in handling. (3) By the plan of circulating the same chemicals repeatedly, it is possible to use certain chemicals of low cost but difficult to solve. And these slowly dissolving chemicals act both as mechanical and chemical precipitants. (4) The working is almost automatic and requires little manual labor. (5) As the action is continuous, without interruption for cleaning, the space occupied by the plant is small compared with that usually required and no time is given for decomposition. (6) As the quantity of mechanical and chemical admixtures is much reduced, the valuable ingredients of sewage in the final by-products transform this into a valuable marketable commodity.

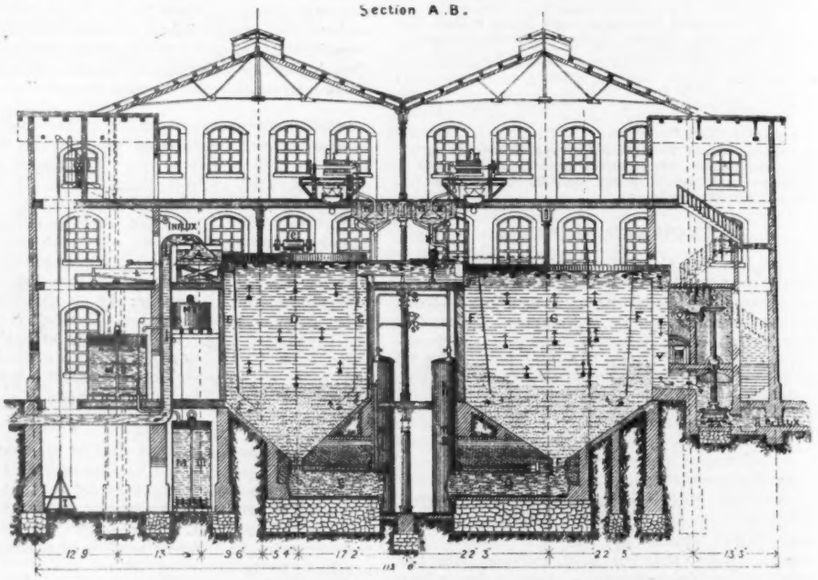
Referring to the plan (Fig. 1), the working of the process may be described as follows:—The waste-water first enters the receiving basin *A* by an inlet pipe and then flows in two opposite directions. (See section *E F.*) The effect of this action is to break the current, and the inclined floor of the basin prevents sedimentary deposit. From *A* the water flows into the lower portions of the outer tanks, *B B*, by way of the connecting pipes *a a*, with hooded outlets. The water rises equally and quietly, and the heavier impurities sink into the receptacles *c c*, which can be emptied by closing the slides *d d* and opening *d' d'*. (See section *C D.*)

The upper edge of the tanks *B B* are on the same level, but lower than the waters in *A*. In a channel leading from *B* to *C* is the endless belt *E*, which removes the scum and other floating particles. As the water enters *C C*, from both sides simultaneously, it practically comes to rest, then descends to the lower edge of the central chamber *D*, and rises in the latter and flows over into the channel *k*. The sediment is here again deposited on the inclined sides and is collected in the cylinder *g*, which can be emptied as was *c*. By way of *k* it flows into the battery *II*, first passing through the mixing tank *X*. (See Section *N O.*)

The sewage passes into the upper part of the tanks *E* (Section *R S*) and follows the direction of the arrows as shown. The sediment in *E* is being continually pumped back into the tank *X* by the small centrifugal pumps *u u* and thus brought into fresh circulation. The sediment in *F F* passes to the receptacle *q*, which is emptied as before described.

From *F F* the water enters from all sides around the lower margin of the cone *G*, over the upper edge of which it flows into the rim-channel *t*. From *t* the water flows through the tube *V* to the turbine *T*, where its force is utilized. (See Section *A B.*)

As described, the waste-waters are submitted to a purely mechanical treatment, by which the heavier sediment is extracted in *B B*, the lighter in *C C* and *D*, and the floating matter also removed. But beyond the tank *X* a combined mechanical and chemical treatment takes place, if this be deemed essential. The chemical used, and admitted at *X*, may be caustic lime, magnesia, a metallic salt or acids and bituminous substances, as the composition of the waste-water and the nature of the by-product may demand.



Lortzing System of Sewage Purification. Sectional Elevations.

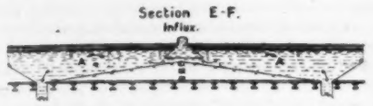
Lime is used in the form of milk of lime, and the limestone should be chosen from that containing the greater proportion of carbonate of magnesia. The office of the lime is to precipitate the phosphoric acid and albuminous substances and to neutralize the acids. The advantage of the magnesian limestone, as compared with pure limestone at equal price, is that about the quantity of the former suffices, and the carbonate of magnesia formed prevents the decomposition of the precipitants.

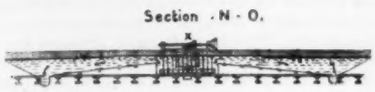
The metallic salts, or their equivalents, form insoluble oxygen compounds, and react favorably with offensive decomposition products, like sulphuretted hydrogen, and from sulphur compounds. Bituminous substances, like creosote and tar, contain carbolic acid, and are only added when it is intended to form asphalt for road-making, etc., and when the waters do not contain such substances in sufficient quantity.

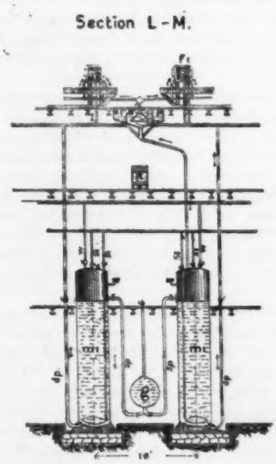
The ammonia in solution in the water may be got rid of in two ways: After precipitating the excess of line by carbonic acid, the ammonia may be precipitated by adding a soluble magnesium salt and phosphate; or it may be absorbed by a solution of magnesia (magnesian limestone) saturated with carbonic acid. The latter may be cheaply obtained from furnace gases or from lime kilns.

M I, *M II* and *M III* (Section *A B*) are the mixing tanks for the chemicals, and *H I* and *HII* are decantation basins which serve to free the water from sediment and fatty matter. Lime, magnesia, metallic salts or their equivalents are added to the sewage in the rim-channel *k* shown in Section *C D*: gases from furnaces or lime kilns are introduced by means of injectors in the basin *Y*; and phosphate and magnesium salts are added in the upper part of *F F*. The use of gases supposes an air-tight cover on *Y* and *F F*.

The products may by treated as follows:—The heavy sediment in *c c* will scarcely repay further treatment, but may be used as manure in the neighborhood. The matter skimmed from the surface by the revolving bands *e e* may have the fat and fibrous matter extracted from it by chemicals, or the fat may simply be melted out. The sludge from *g*, taken up by the vacuum presses *M I* and *M II*, may be treated with acid and forced to the filter presses *f I* and *f II*, and sold as manure. The most valuable sediment comes from *q*, and it may be treated as was the last.







The description gives no estimates of the cost of the plant, and the capacity of the plant illustrated is set down at 5,000,000 galls. per day. But any further information can probably be obtained from Mr. ROBERT FABEBY, 272 Tremont St., Boston, Mass., who represents the inventor in the United States.

The Design and Construction of Railway Shops.*

The author wishes to record a few notes on the design and construction of railway shops, and purposes, not only to treat of the peculiarities that mark those of North America, but also to contrast some features with European practice, and if possible to indicate what is and what may be the modern development and progress in this art.

LOCATION.

A natural starting-point is the location of the shops with reference to the terminal stations of the railway and to some large town; also the choice of land and its amount. A statement of the best American practice in this matter is given by Mr. C. PAINE in the chapter on "Shops and Engine Houses" in his "Elements of Railroading." A point he strongly emphasizes, that more than enough land should at first be purchased, even if afterwards it is sold as building lots, will receive a unanimous endorsement.

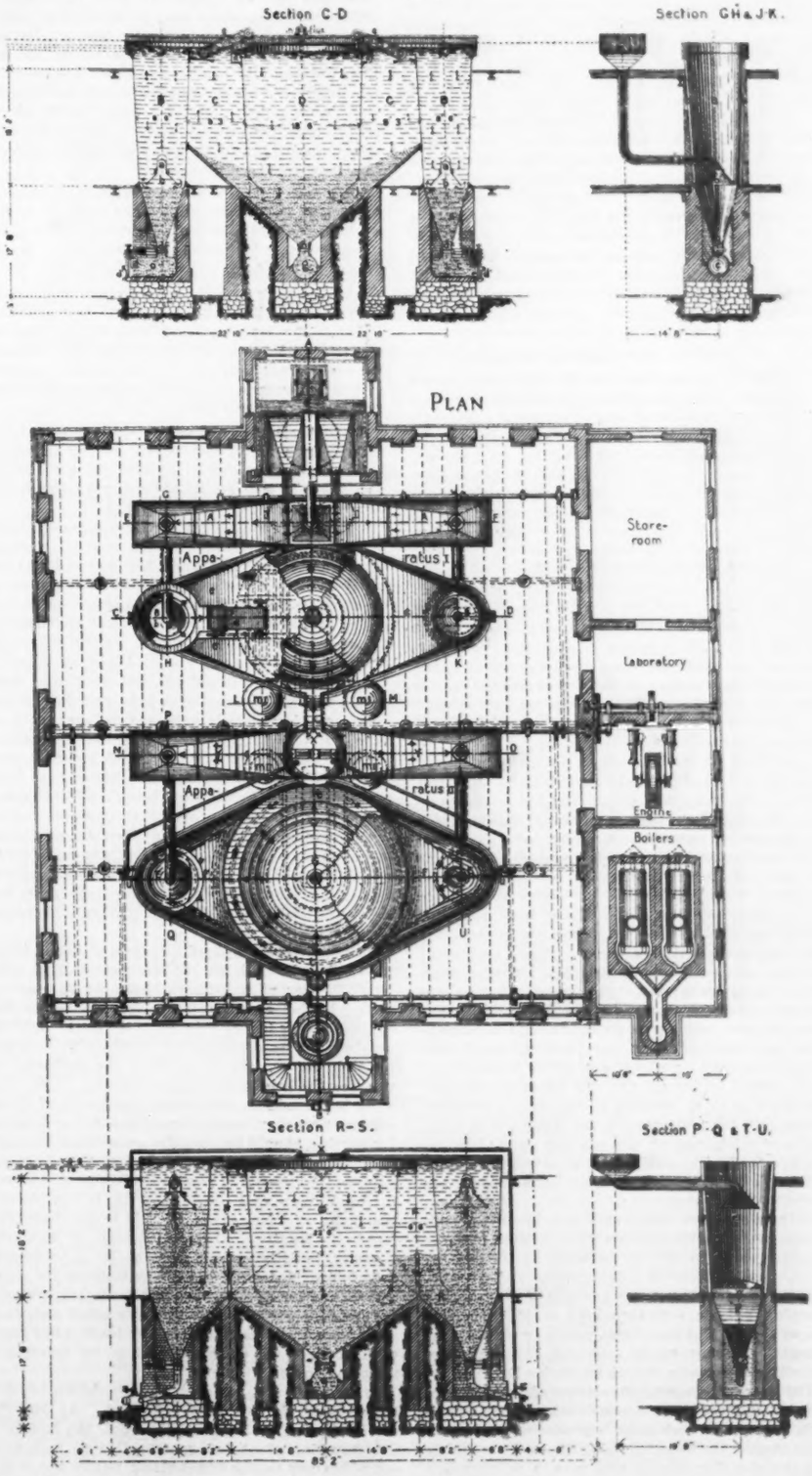
FOUNDATIONS.

It would, for the present purpose, be a waste of time to enumerate those matters common to all dry, solid, and effective foundations, but it may be remarked that in northern climates, it is better that the sides of foundation walls and piers be sloped rather than stepped, so as to prevent as much as possible the earth gripping the wall, as it expands under the action of frost.

When the main supports of the overhead weights —such as roof-principals, crane-tracks, shafting, etc.,—are iron pillars; and "made ground" covers to any depth the natural foundation bed, the comparatively low price of iron has proved it to be economical to build short foundation piers, and to allow the iron pillars to run down below floor level, to the piers, instead of carrying up the piers to floor level, the pillars being socketed into broad cast-iron bases, bedded in cement.

Pillar footings and column bases, when above floor level, are usually bedded on rolled sheet or melted pig lead. The author is of the opinion that the running in, between base and cope stone, of a fine cement grout, would be as neat and effective, and certainly cheaper. Less concentrated weights, such as stationary engine and pump beds, and the footings of heavy machine tools, are satisfactorily bedded on their foundations with melted stick-sulphur.

Another instance of iron being used to reduce the first cost of foundation may be seen in the new erecting shop of the Grand Trunk Railway at Stratford, where, instead of making continuous walls to



Lortsing System of Sewage Purification. Plan and Sections.

*A paper by J. DAVIS BARNETT, Assistant Mechanical Superintendent Grand Trunk Railway, in the Transactions of the Canadian Society of Civil Engineers.

carry the rails supporting the traverser table, it was found less costly and quite as efficient to build disconnected piers, and span them with wrought-iron beams of I section, which carry the rails laid upon them longitudinally, and support the flooring laid transversely.

WALLS.

It is advisable to emphasize the apparent wall construction: a good shop *looks* substantial. This is best accomplished by using bold pilasters or large piers to receive all roof and floor beams, setting them so that they stand out prominently, and spanning the panel between them with comparatively thin bonded walls, free from bats, if of brick.

This method of straight lines and prominent offsets not only satisfies the eye, but is of pronounced value in localizing and absorbing the vibrations received from the roof or machinery, and closer attention to these matters would result in our shops having a less tame, a less ugly, appearance, and a longer safe life. The permitted outlay on such new works rarely admits of the wall surface being broken into ornamental lines, or varied in color; but it is always possible to make a strong bony skeleton, whose very angularity will instinctively satisfy, by appearing to be quite equal to its special duty.

ENGINE HOUSES OR LOCOMOTIVE SHEDS.

Intended for little else than the temporary storage of locomotives, engine houses in America vary more in first cost and permanence of material used than in type of design. The ordinary arrangement in plan is an annulus or segment of an annulus, whose center is that of the unroofed turntable, giving access to the radial tracks, each leading into a single locomotive stall. The economics in the construction of the annulus are: either a narrow span of trussed ridge roof: or a so-called flat roof (angle of 5°), offering little obstruction to wind, and permitting the use of an inexpensive roof covering; low walls—the roof timbers are sometimes lower than the top of the engine chimney—and a short length of wall, as it is limited to the ends and outer ring, the inner ring being formed by the wooden door and door posts. A flat roof supported by pillars gives a very stiff building for the limited amount of material used; and if sloped inwards, the roof drainage is a simple matter.

The stack of the locomotive, naturally going to the higher part of the building, brings its front end close to the outer wall containing the windows, so that the most light is received where it is needed—on the moving part of the machine.

Extending back into sparsely settled districts, as do many of the new railways on this continent, the primary consideration in the erection of their buildings is low first cost, a future development of traffic being relied upon to provide the revenue for erecting permanent structures. Hence, segmental engine houses of wood, with flat, gravel-covered roofs, are common; and if the materials for the ash-pit, and its drainage, do not prove unusually expensive, they can be built for $850 per stall, the foundation consisting of cedar posts, 6 or 8 ft. apart, carrying a mud sill, on which rests a pine frame of 6 to 8 ins. square scantlings, the roof being single sheeted with 1 or 1¼ in. tongued boards, and coated with paper felt, tar, and gravel; the ashpit, 25 ft. long, being of brick or stone, and one iron smoke-jack being provided. The shell of a similarly roofed building with brick walls and stone foundation costs about $1,000 per stall.

It was common some years ago, in northern climates, to sheet with inch boards on both sides of the scantling, and to fill in between with sawdust. This hastened decay by holding water and vermin, and the better practice now prevails of putting both sheetings outside, with tarred felt or thick paper between them. The use of clapboards or shingles for outside sheeting much improves the otherwise primitive appearance of such an engine house.

The more permanent structures of this class are of brick, and those of modern date have roof principals, rafters, and deck-ridge beams of wrought iron throughout; the covering being of slate, preferably of small size, 8 x 16 or 9 x 18, with a quick angle or slope, at least equal to ¼ of span, which is never less than 66 ft.

In Canada, slate is rarely used for shop-roof coverings. Mr. J. W. HARKOM (Member) informs the author that he has used New Rockland slate on an engine house in Maine for five winters without repair being needed, and he is familiar with roofs that have been covered with it for ten years, that show no injury from frost. Our native slates are very compact,—a point greatly in their favor. A report of the State Geologist of Vermont shows that the slate in this neighborhood has a water absorption (under vacuum test) of but $\frac{1}{15}$ of its weight. Mr. HARKOM also mentions a successful experiment he carried out at Athabaska, with the object of getting rid of the icicles that form at eaves, due to melting from heat communicated through the roof slating. He double-boarded or sheeted on the purlins, and then laid wood strips 1½ by 1 in. thick on top, at proper distances apart, to which strips the slates were nailed. The air space below secures fairly equal temperature on both sides of the slate, thus preventing the excessive eave icicles common to slate-covered engine houses.

The fire risk from a roof covering of shingles set in cement, and occasionally lime-washed, is very slight; in fact, in high winds, with many live sparks flying about, it is probable that shingles so treated are safer than slate.

A liberal surface of glass is provided in the outer ring wall. Skylights flush with roof, being difficult to keep clean both inside and out, are of little use; and the small portion of each large door (forming the inner ring) that can be fitted with windows makes it necessary to depend largely on the outer ring wall for natural light.

As to the number of engine stalls required, any railway in a moderate climate, having an engine house capacity equal to 60 per cent. of the locomotive stock, is well equipped; many American railways being content with 50 per cent.

In Great Britain a very common form of engine house is the longitudinal, with parallel through tracks, and exit at both ends. Their capacity varies, rarely exceeding 80 engines. The roof is usually of the saw-tooth pattern, a series of narrow spans, supported by hollow iron pillars, forming conduits for the water from gutter in roof valley to underground drains. The roof is hipped unequally, favorite angles being 60° and 30°, and that side more nearly vertical is glazed with ¾ in. rolled or rough plate, and if possible is arranged to face north, so as to give a good light equally diffused throughout the wide building, without too much inconvenience from the direct rays of the sun. Snow and frost prevent the saw-tooth roof being used in Canada, (the author not knowing of a single example on this continent north of the State of New Jersey); hence our roofs are of single slope ("flat") or single ridge of quick pitch; and as skylights have but a partial efficiency, the necessity for securing light from the side walls limits the width of a longitudinal engine house.

An excellent example of this type of house, built by the Grand Trunk Ry., at Montreal, is 76 ft. wide by 282 ft. long, with five parallel tracks through it, giving liberal accommodation for 25 long tender engines. Any increase in capacity could only be obtained by lengthening the building and tracks, which increases, out of all ratio, the difficulty of working the longitudinal type of house. This difficulty is the trouble and extra movement of other engines necessary to get a locomotive out and ready for service, should one on the same track in front of it be undergoing for a few hours such light repairs as the renewal of truck wheels, that prevented it from being moved until the work is completed. American criticism says that this is the main defect in the longitudinal type of house. It does not, however, in daily practice prove to be as awkward as it looks, if definite tracks are reserved for such repairs and for such engines as have to keep "shed-day" while their boilers are being washed out, and if the house-men (engine turners) learn what part of the house each engine should go to, before attempting to put it under cover.

Exit at both ends of such a house cannot be obtained where the yard room is limited. At Cardiff, on the Taff Vale Railway, England, the Locomotive Superintendent, being compelled to have one end of his new engine house blank, put in the middle of its length a traverse pit and table, crossing its ten tracks and then passing out, through a pocket on side wall, to a parallel siding in the yard. This gives practically three exits, with exceptional economy in space. (See Proc. Inst. C. E., August, 1884, p. 243.)

The Great Western Railway of England has, in many of its engine houses, combined both the longitudinal and the radial systems under one continuous hip and valley roof, and the Northeastern Railway, England, had such a preference for the radial system that five turntables were put under one roof, 280 ft. wide by 450 ft. long, giving stallage for 95 engines. This is an extreme case and is probably unique, although in passing, it may be noted that the late HOWARD FRY, in designing the extensive workshops for the West Shore Railway at Frankfort, N. Y., laid them out so that the smithy, boiler-shop, foundry, erecting and machine shop stand radially to an open turntable. Having, however, unlimited land at his disposal, the tracks from the outer ends of these buildings are connected by easy curves to the yard sidings, so that a failure of the turntable or the blocking of its pit will not necessarily block up all entrance to these shops, such being the case with the tracks in an engine house which converge on a central turntable as their sole means of exit. The Burlington & Missouri River Railway at Plattsmouth, Neb., also has most of its shops in the shape of segments of an annulus centering on one turntable.

The best radius of track curve is an unknown quantity, but the New York Central Railway safely uses curves as sharp as 160 ft. radius for their city freight-house.

The author would strongly endorse the longitudinal type of engine house. It is eminently serviceable where a large number of engines have to be turned out almost together in the busy portions of the day. An English officer, daily handling about 400 train engines at one terminal, in comparing the two systems, said that if turntables controlled the exit of his engine houses, he believed it would be impossible for him to get the engines out on time for their trains, even with additional space and men placed at his disposal.

And this type as readily suits small establishments. An engine house recently erected by the Grand Trunk Railway at Lindsay (under the supervision of the author) is 250 by 62 ft. It has two through tracks, with continuous ash-pits for 10 running engines, one through track for engines under repair, being washed out or waiting under steam between trains. Parallel with the window of one side wall are two stationary boilers with overhead apparatus for sand storage and drying, three smiths and other fires, a stationary engine, a force pump with underground water supply tank, and still continuing in line with the shop and main shafting are wheel lathes and other iron-working machinery, the fitters' benches, and the wood-working tools and benches, followed by foreman's office, clerk's office, and a two-storied storeroom, with oil tanks below ground, the whole resulting in a cheap, compact arrangement, every foot of floor space being used, while every corner and detail is well under the eye of the foreman. The tracks in yard form a triangle (or Y, as it is called), and a turntable with its pit is dispensed with, thus getting rid of one source of probable failure and delay in getting engines out "on time."

Many engine houses are now equipped with a continuous pipe 1½ or 2 ins. diameter, having branches to each stall and flexible couplings to each engine. Its uses are various. The steam and water from a boiler to be "blown off" and washed out are sometimes used to heat the water with which the washing out is to be done. The pipe may be passed into a boiler of cold water, so as to shorten the time in raising steam after a washed-out boiler is refilled, and sometimes it is connected with the jet blower at base of locomotive chimney, and the steam used in creating a draft to quicken the newly lit fire. The two latter arrangements prevail where an injector or inspirator is used to give the washout water-pressure.

OIL HOUSE.

A special feature of American engine-houses—the outcome of the extensive use of mineral oil for lubrication as well as for light—is a detached oil house, a fireproof brick structure, with iron roof, roof covering and shutters, and concrete or asphalt floor. Underneath it (below track level) are iron storage reservoirs, with inlet pipes so arranged that oil received in bulk can gravitate from the tank-car into any one of them, from whence it is lifted by hand or steam pump into small tanks on upper

floor, and is drawn thence by tap for engine and train use.

The concrete floor is at level of car-floor, or about 4 ft. 2 in. above rail level, to facilitate small shipments to out-stations, which in the more perfect equipments is by means of circular iron tanks holding 60 galls. The cellarage around storage tank and the house is warmed by steam pipe from outside, and the artificial light is gas, or, as at Indianapolis, electric, no lamp or torch being admitted.

SAND HOUSE.

The sand used to increase the adhesion of locomotive wheels would at first sight seem to be too small an item to require specific attention; but eight or ten tons is a daily issue at central stations. At Columbus, O., the sand store, having a capacity of 1,000 tons, is a neat wooden building with hinged shutters at top of walls, set so as to permit the air to assist in sand-drying; and the floor is of dry brick set on edge, with tile-drain below. When required for use, the top layer of sand is shovelled into hoppers, containing live steam pipes one inch diameter and spaced two and a half inches apart; when dry it falls through bottom opening onto a concrete floor.

The Grand Trunk Railway has recently, by hand power, belt and bucket elevators, lifted the dry sand into overhead reservoirs, from whence it is allowed, through hose and molasses gate, to deliver directly into sand-box on top of locomotive boiler.

(TO BE CONTINUED.)

The Work of the Lobnitz Rock Dredge.

In our issue of January 26, 1889, we gave some details of this new and remarkable process of excavating rock under water by percussion without use of explosives or drills, with a cut of the new dredge-boat *Dérocheuse*. This dredge was then about to be sent to Suez. A recent paper by Mr. FREDERICK LOBNITZ, Assoc. M. Inst. C. E., before the Institution gives very full and complete records of the actual workings of the dredge at Suez, and of the teachings of the experience there gained.

In view of the novelty and importance of this process, which has as yet been applied on a very limited scale in this country, if, indeed, it can fairly be said to have been applied at all (some extensive rock dredging at the Sault Ste. Marie has been done in much the same way, at a cost of $1.62 per cu. yd.), we reproduce below nearly the whole of this paper from the Proceedings of the Institution, including some details in the early part of the paper which we have previously given, but which we think it will be for the convenience of our readers to reproduce, as the space thus lost is not great. For the same reason we reproduce from our issue of Jan. 26 the cuts we then gave of this machine. Mr. LOBNITZ' paper is in substance as follows:

Fig. 1. Irregular Excavating with Rams in Conglomerate at Port Tewfik. Scale ¼.

As the removal of subaqueous rock is one of the slowest and most difficult of the works undertaken for the improvement of harbors, rivers, and canals, it may be of interest to describe a method of shattering and then dredging subaqueous rock, by which the danger of blasting and unforeseen delays and expenditure are avoided. The system consists in letting fall a heavy, suitably-shaped mass on the surface of the rock, which shatters it as artillery fire demolishes the stone walls of a fortress.

Mr. HENRY LOBNITZ, shipbuilder of Renfrew, invented this system of rock-cutting rams in view of the rock excavation necessitated by the widening and deepening of the Suez Canal through the strata of rock between the Bitter Lakes and Suez, which has to be executed under water without intercepting or endangering the incessant traffic passing along the canal.

A steel-pointed rock-cutter, weighing 2 tons, was experimented with at Craigmillar Quarry, Edinburgh, being raised by a steam-winch on a frame, like a pile engine, running on rails. With a fall of about 18 ft., over 4 cu. ft. of the hard rock were dislodged on the average, per blow. The first blow, delivered 3 ft. from a face, made an almost imperceptible crack in the rock; a second and third blow on the same spot opened the crack, about 5 ft. long by 3 to 4 ft. deep; and at the next blow, the wedge-shaped point of the cutter generally entered the crack and split off the piece of rock. Striking blows out of sight under water, on an unknown surface, modified the conditions of the experiments on land; but, nevertheless, the *Dérocheuse*, the first rock-cutting machine built, fully confirmed the expectations of the inventor, and has been purchased by the Suez Canal Co. for widening and deepening the rocky portions of the canal.

The *Dérocheuse* is a vessel capable of navigating independently; and in spite of the height of the framing, the metacentric height is over 5 ft., owing to her great beam, giving a good stability curve. She steamed out to Port Said from the Clyde in 20 days' steaming time, encountering several severe gales. The hull of this rock-cutting dredger is 180 ft. long by 40 ft. broad and 12 ft. deep; the mean draught is 9 ft., and there are 18 water-tight compartments. Five steel-pointed rock-cutting rams, each weighing 4 tons, are arranged in line on each side of the central well, through which the buckets lift the crushed rock (Fig. 3). Hydraulic power raises them to a height of from 5 to 30 ft., and they are then let fall on the rock. These rams can work on each side of the lower tumbler, or they can be moved by steam-power either forward or aft, to suit the position of the dredging gear or the requirements of the work. With the set of hydraulic levers, placed below the steam-crane, between 200 and 300 blows per hour can be delivered with one set of five cutters. Combined with the rock-cutting apparatus, dredging machinery, specially adapted for lifting broken rock, is provided. A guide-wheel is fitted which supports the sag of the bucket-chain when wear has taken place, and relieves the strain on the bearings and pins. With this guide-wheel, or relieving drum, the maximum dredging depth of the machine is 40 ft.; without it more than 30 ft. would not be attained. Some old dredgers, to which such a guide-wheel has been added, have been able to dredge 15 ft. deeper than before, and with greater speed, of which the Clyde navigation dredger No. 8 is an instance. For driving the bucket-chain, there is a four-cylinder two-crank compound engine of 200 I. H. P., which by special friction-gear works two steel pitch-chains passing round pitch-wheels connected to the upper tumbler. If the buckets catch on solid rock, the friction gear slips until the undue strain is relieved.

Fig. 3. Form and Arrangement of Rock-Cutting Rams. Scale ¼.

While at work, the vessel is moved over the surface in a series of arcs, by independent winch motion arranged for swinging the vessel from side to side, pivoting on a steel mooring pile, which goes down through the hull in the after part of the machine, as shown in ENGINEERING NEWS, Jan. 26, 1889. There are two of these pivot piles manœuvred by hydraulic power, which enable the vessel to advance an equal distance after each swing, and which prevent her from losing position. This double pivot system of working is useful for accurate rock-breaking, when the vessel is situated on a large surface of water, where a dry land base of operation cannot be had. There are two jib cranes; one 3-ton hand-crane on deck for repairing the bucket-chain; and the steam-crane of 6 tons, placed on the top of the framing which supports the hydraulic hoists for the rock-cutters, enables the latter to be easily removed and replaced. For navigating purposes, twin screw-engines of 300 I. H. P. are provided. There are 2 independent boilers, with a working pressure of 75 lbs. per sq. in. Two sets of automatic hydraulic pumps are fitted, working independently with separate lines of piping to the hoists, so that repairs can be done while at work. A separate three-cylinder engine actuates the condenser pumps, which causes the vacuum to remain constantly efficient. The ladder-hoist engine is placed forward, and winds the chain round a large grooved barrel. An accumulator is used to regulate the hydraulic pressure, and to raise or lower the pivot piles.

In designing this machinery, much care was taken to make it specially suitable for what it was expected the conditions of actual work would be; and few of the arrangements adopted were found to be unsuitable for the task which they had to perform.

The every-day work was carried out under the supervision of the author; and the daily log of the first few months is a record of experiments with different systems of using the machine. The system finally adopted as the best may be accepted as an advantageous manner of using rock-cutting rams combined with dredging apparatus under similar circumstances.

At the Red Sea end of the Suez Canal, the mooring place for vessels has a variable conglomerate bottom containing gypsum, sand, and sometimes shell. On this bed of variable rock, the machine was first put to work. The mean depth of water, of about 27 ft., has been ample for the traffic until recently; but as the variation of water-level in the Red Sea is from 6 to 10 ft., the depth of water at low-water is scarcely sufficient for the increased draft of the large liners. The surface of this rock has been attacked by powerful dredgers in past years, but this plan was expensive, owing to the great damage done to the dredgers, which could only scrape away the soft surface and soft places, and continually had serious break-downs. These dredgers, although of a good type, could only load one barge of 200 cu. yds. of clay and rock, in from a week to a fortnight; and

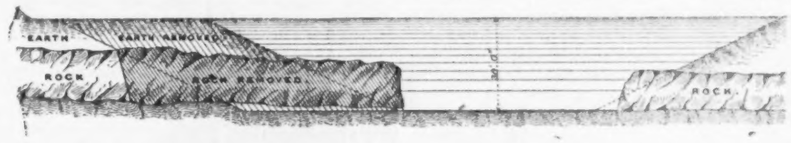


Fig. 2. Section of Enlarged Canal showing Rock Removed. Scale 50 feet to 1 inch.

their daily advance was often not more than 2 or 3 ft. where the *Dérocheuse*, later on, did from 20 to 30 ft. with the same depth of cut. However, the Port Tewfik rock had been thus lowered a foot or two over a surface of about 10,000 sq. yds.; and this method was only stopped because the rock got harder below the original rotten surface, making progress slow, especially as the dredgers required to be under repair very frequently. Thus, where the rock-breaking machine started work, the surface was clean and of a genuine rocky nature, the thickness of the bed being so great as not to be definitely known. It speedily became apparent that the conglomerate, having a large proportion of gypsum in its composition, was so elastic and tough that the blows of the sharp-pointed rams had no splitting effect on it whatever. Each blow of a cutter made a hole in the rock, varying from 6 ins. to 2 ft. in depth; and a second blow, delivered even quite close to the first, made a similar square cavity, leaving the wall of rock between the two holes intact to all appearance. The partition of conglomerate between two such holes was sometimes only from 4 to 6 ins. in thickness, yet showed no cracks such as had been anticipated from the dry land experiments. This result, due entirely to the peculiarly tough nature of the formation, led for a short time to the supposition that the effect of the cutters on this rock under water would be nil.

When starting actual work after these experiments, the cutters were moved forward of the lower tumbler, so that when working at from 30 to 36 ft. of dredging depth they would always be in front of it. After being placed in position, the machine was pivoted on the central pivot, the cutters delivering a series of blows, 5 ft. apart, while describing an arc about 65. ft. broad by 8 ft. long. When the first arc was finished, the vessel was advanced 10 ft. forward, and the pivot again lowered. As the lower tumbler was not over the rock which had been operated on by the cutters, the bucket-chain was set in motion, and the second swing commenced, all the mechanism, cutters and buckets working together. The dredger lifted the rock, but not easily, as shown by the frequent slipping of the friction-gear, when the bucket slid over or caught on solid rock. During the delivery of each series of 10 blows, the manœuvring winches were stopped, and the swing of the vessel was interrupted, so that each row of cutters might deliver 5 blows in line. After each series of such blows, the machine was pivoted to the next position, and the operation repeated. As the buckets did not lift the rock with the ease to be expected, had the rock been thoroughly disintegrated, it was decided to deliver the series of blows closer together than 5 ft., so as to leave almost no surface untouched.

A diver, sent down, reported that the surface of the rock behind the machine was in small hills and valleys, running parallel to the axis of the vessel (Fig. 1). Each row of blows so crushed the rock that the buckets were able to penetrate and lift it. But where the rock was untouched by the cutters—the part represented by the hills—the buckets merely slipped over it, lifting the ladder, and sliding violently over the rock. The hills on the surface were exactly spaced between the lines of blows. To avoid this bad work, caused by delivering the blows symmetrically spaced, it was resolved to pivot the dredger slowly, but uninterruptedly, through each swing, delivering blows continuously, and dredging at the same time. Before trying this, the rock was attacked with the buckets alone, to see whether it would not be

possible to lift it without first indenting the surface with the cutters. This attempt, however, in spite of the great power and strength of the dredger, had to be immediately abandoned, as the buckets came up empty, and merely slipped violently over the rock, whipping on the ladder and injuring the machine more than the conglomerate. The promiscuous delivery of blows gave better results in speed, and left a level surface; but, owing to the variable nature of the rock, the cutters were in a few days traversed nearer to the lifting bucket, and it was found advantageous to have the cutters thus alongside the buckets, because they acted on the rock immediately before and after the buckets. When a hard and brittle patch of rock was met with, requiring fewer blows to disintegrate it than the softer and tougher quality, no time was lost in delivering unnecessary blows, as the buckets showed instantly whether the rock was sufficiently loosened or not. Again, when a greater depth than 2 ft. of rock had to be removed to attain the required section, it could be done in two or three swings, pivoting on the same spot. This was found to be quicker and easier, as the buckets lifted away the crushed or broken surface between the two rows of cutters, allowing the second row to have more effect on the rock, falling on a surface not covered by the débris resulting from the blows of the other row of cutters.

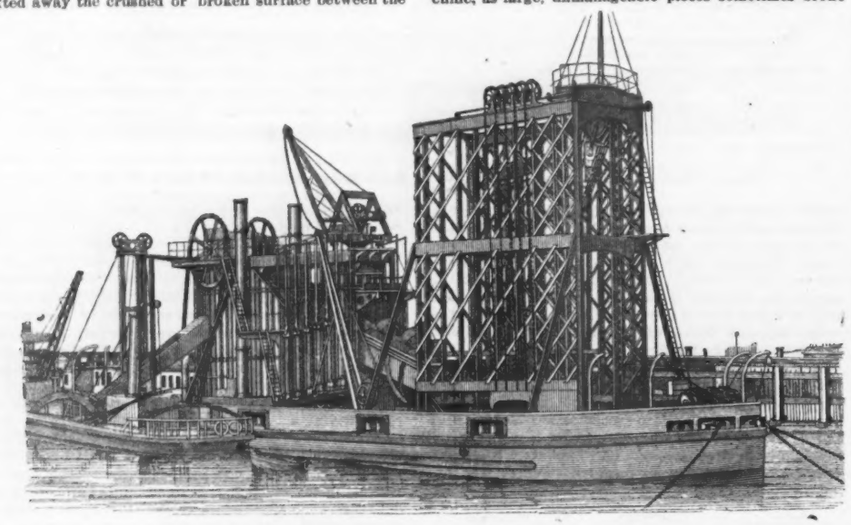


Fig. 4. Rock Dredger "Derocheuse."

After working for seven weeks on this peculiar conglomerate in the Red Sea, it was thoroughly proved that the best method of employing the machine, in that kind of rock, was to have the cutters close to the buckets, and to work with dredger and rock-cutters together, advancing about 1 yd. each swing. As it was now clear that all the rock of this nature could be removed by the *Dérocheuse*, it was decided to take the machine about 15 miles along the canal to the Chalouf Rock, a very hard bed of rock, and quite different in nature and position from the Port Tewfik conglomerate.

The results of the work in the conglomerate were as follows: At first the cube done each day varied greatly; but after the first few weeks, the output became more regular, owing to the crew becoming more skilled in the working of the machine, for the conglomerate was very variable; at one place hard and tough, like malleable iron, it would often change quite suddenly to hard, brittle patches, surrounded by softer and more elastic parts rich in gypsum. Pockets of yellowish clay were also sometimes met with, embedded in the rock, and in these the cutters often stuck fast. One or two of the neighboring hydraulic chains were then attached to the cutter, and extracted it in a minute or two. The total outlay for working expenses and repairs during the last five weeks at Port Tewfik, for the breaking and extraction of 2,100 cu. yds. of pure rock, was $1,725. Thus the cost per cu. yd. of pure rock, lifted in pieces weighing from one-fourth to two cwt., and put into the barge, was about 82 cts., exclusive of insurance, interest, depreciation, or management.

Working days, 25. Working hours, 244. Pure rock excavated, 4,048 tons, say 2,100 cu. yds., exclusive of 1,401 tons of clay, sand, and pulverized rock excavated.

$$\left.\begin{array}{ll}\text{Working expenses} & \$1,000 \\ \text{Repairs and alterations} & 725\end{array}\right\} \$1,725$$

$$\text{Cost per cu. yd.} \frac{\$1,725}{2,100 \text{ cu. yds.}} = 82 \text{ cts. per cu. yd.}$$

Before leaving Suez, the machine was put into as good condition as when it first began work. New guides were made for the cutters, as the original ones proved too weak. The cost of these repairs, and of all alterations and improvements, is included in the above price of 82 cts. per cu. yd. While operating in the deep water on the conglomerate, no breakages occurred; the guides only of the cutters wore out, being made of unprotected wood and not strong enough. This shows that a machine, properly made for a conglomerate, could remove it at least as fast as the *Dérocheuse*, and without more wear and tear than in ordinary dredger working in sand.

The machine commenced operations on the hard rock at Chalouf on May 30, 1888. Instead of a variable tough conglomerate, the Chalouf bed consisted of unstratified hard rock, varying in thickness from 5 to 10 ft., with clay strata below. A strip of this rock, about 20 yds. wide and 200 yds. long, had to be removed on the Asiatic side of the canal. This work, the first stage of the widening of the canal at this point, is now finished. The depth of water over the surface of the rock where the machine worked varied from 8 to 22 ft., as the rock inclines towards the north (Fig. 2). An almost vertical wall of rock was left towards the African side where the channel was excavated dry in making the canal; and this face was disadvantageous to the work of the machine, as large, unmanageable pieces sometimes broke off. When the cutters fell on this rock, they gave a clear metallic ring, quite different from the dull thud that usually followed a blow on the conglomerate in the Red Sea. A cutter being lowered on to the surface of the rock, which had been previously all scraped free of clay, etc., by another dredger, and the depth of immersion noted, it was allowed to fall on the rock from a height of 6 ft. The immersion of the cutter, however, was unchanged, which showed that it had not indented the rock, as would have been the case at Port Tewfik. After a second and third blow on the same spot, the cutter was seen to penetrate, and was found to have pierced through the bed to a depth of 5 ft. A fourth blow on the same spot gave no metallic ring, the cutter sticking deep in the clay strata below the rock. Regular work was then commenced, a surface of rock being shattered by blows of the cutters working alone.

The diver, on examining the surface worked over, reported that the rock was completely broken up and disintegrated, the fragments varying greatly in size. Sufficient surface having been operated on by the cutters to allow the bucket-ladder to effect an entrance into the rock, the dredger was put to work, and immediately the buckets brought up freshly-broken stone of very hard quality in pieces weighing up to ½ ton. These blocks fell in the shoot of the dredger with a noise like thunder, and rattled down into the barge in a continuous stream. To receive the shock of such pieces, a heavy iron flap-door had been suspended on the end of the shoot, next the barge, to prevent the latter from being injured or sunk; and, where the broken rock falls over the upper tumbler, a mild steel armor-plate, 10 ins. thick, receives the shocks, and prevents injury being done to the framing of the dredger. The barge was filled with 350 tons of rock without any other mishap than the smashing of the flap-door suspended on the shoot to protect the barge from the falling stones. The diver, on examination, found several blocks of rock weighing each about 1½ tons on the otherwise perfectly dredged surface. These blocks had been rolled before the buckets, which could not lift them, owing to their size; and, as they rested on the soft surface of the clay strata, there was no possibility of breaking them smaller by a blow from a cutter. As it would have been imprudent to dredge again with such stones behind the lower tumbler, owing to the risk of rolling them into the traffic channel alongside the bed of rock, it was decid to lift them at once with the crane, the diver attaching a sling to each. However, the operation of lifting these blocks with the diver's aid, notwithstanding good appliances, took as long as the loading of the first barge had done; and the rock so lifted cost $10 to $20 per cu. yd. Hoping to avoid breaking off such large pieces, the blows of the cutters were spaced closer together, and the work proceeded. The cutters were kept in front of the buckets, and the rock broken during one swing was dredged in the next. It was speedily found that the cutters, although not working quite close to the cutting edge, still had an enormous effect, breaking off from 25 to 50 cu. yds. per hour. However, this result was quite useless under the circumstances in Egypt, because the dimensions of the pieces broken off by this method were quite beyond control; and the buckets could not catch and lift any block above 1 ton in weight. At each swing the buckets rolled the large blocks to one side, lifting only the small and medium-sized pieces; and as the traffic channel had to be kept free from blocks, it was not possible to work with safety so long as the rock could not be broken quite small. Moreover, the diving work was very costly, especially as the tidal currents interfere with such work at Chalouf.

Whilst working close to the cutting edge, it was found impossible to prevent large pieces being broken off reaching 4 and even 8 cu. yds. To enable the rock to be broken smaller, the operations of dredging and rock-cutting were separated, so as to allow the cutters to work farther away from a face. In this way the blows of the rams fell on rock supported on all sides; and, instead of being cracked off in blocks weighing from 1 to 15 tons, the rock was broken up quite small by the repeated blows, something like ballast for concrete making. Naturally, more time was required to thus pulverize the rock, as repeated blows had to be delivered on the same spot in order to pierce the bed, which was, however, always accomplished with certainty even with a thickness of 10 ft. of rock. Only 5 of the 10 cutters were used in this system of working, as it was found that, for separate rock-cutting and dredging, one row of cutters was more convenient for accurate work than two rows. From 10 to 15 cu. yds. of rock were broken to ballast size per hour of rock-cutting. Dredging the rock pulverized in this way caused no undue efforts to the bucket-chain, which lifted the rock as if it were gravel at the average rate of 30 cu. yds. per hour. The dredger would have lifted about 50 cu. yds. per hour if it had not been necessary to dredge in one direction only, and swing back without advancing, so as not to risk rolling any débris into the traffic channel alongside the rock. This method solved the difficulties experienced at first, although several items in the machinery required modification. For instance, while dredging the pulverized rock for the first time, one of the blocks got between the buckets and the lower tumbler, causing the chain to ride over the flanges of the latter. A new tumbler of special design was accordingly substituted for the original one, which was of a type well adapted for dredging clay or soil, but not for dealing with rock where large blocks might occasionally be met with. At the same time larger chains were put on to the hydraulic hoists, as the chains 1-in. in diameter, originally fitted, were too small to stand any wear with the additional hydraulic pressure put on to draw the cutters out more quickly when they stuck fast. The 10 original cutters were also replaced by heavier ones, differently shaped, to reduce the vibrations in the shallow depths at Chalouf. These improvements occupied the latter part of the month of June and the first three weeks of July, 1888, as the various parts had to be sent to Egypt from Glasgow.

After the alterations, the *Dérocheuse* worked for 42 days from 5 A. M. to 7 P. M., Sundays and week-days without stoppage, except when the canal traffic required it. In the beginning of September the boilers were cleaned, being dirty with deposits from the Nile water; and the pins in the bucket chain were changed for the first time, being worn with the gritty débris of the rock. A similar overhaul is required monthly for all machines on the Suez Canal. Towards the end of September, the *Dérocheuse* was acquired by the Suez Canal Company, being found capable of removing the rock in the channel without inconvenience to the navigation, and with greater speed and economy than could otherwise be done.

The total expenses of the work during two months at Port Tewfik, and three months at Chalouf, were $9,800, while 7,659 tons, or say, 4,000 cu. yds. of pure rock were lifted, making the cost about $2.45 per cu. yd.* As the total cost of working the machine was about $0.72 per cu. yd. of pure rock extracted, and the abnormal repairs and alterations, chiefly owing to the novelty of

*Expenditure at Port Tewfik and Chalouf during the first five months:

General expenses, crew, coal, stores, etc. (74 working days)	$2,990
Improvements, alterations, and repairs	3,520
Replacing cutters, and two broken	1,390
Transport and storage	1,900
Total expenses (74 working days)	$9,800

Pure rock removed, 7,657 tons = 4,000 cu. yds. Working hours, 474.

the apparatus, amounted to about $1.73 per cu. yd., excavated, it is apparent how economical the system should really be. With the pure rock, 2,177 tons of clay were also lifted, but the results for pure rock only are given. These were the results of the experimental period of the work of the *Dérocheuse*. But during August the crew and all the machinery got into working order, and in September a careful record was kept for 16 days, during which 1,936 tons of pure rock, say 1,000 cu. yds., and 249 tons of clay were lifted in 111 hours' work, the average working day at Chalouf being under 7 hours, owing to the navigation. Ordinary repairs only were required, and the following table therefore shows the normal expenses of the machine working in hard rock. The barge which carried the broken rock 20 miles away is not counted, as this factor varies so greatly with circumstances.

DETAILS OF EXPENDITURE OF THE LAST SIXTEEN DAYS AT CHALOUF.

Crew (23 men) at $2,76 per hour, 140 hours' pay.....	$387
Coal at $7.29 per ton, 3 cwt. per hour for 140 hours	153
Oil and stores	43
Fresh water, 16 days at 10s. 6d	41
Upkeep, sundries, etc.....	8
Total expenses for 1,000 cu. yds	$632

$$\text{Cost per cubic yard of pure rock} = \frac{\$632}{1{,}000} = 65.2 \text{ cts.}$$

Although the 1,000 cu. yds. of hard rock were excavated at a cost of 63 cts. per cu. yd., it would be quite wrong to treat this figure as a basis for continuous working, for at the end of a year's work many parts of the dredger would be worn, and the repairs required each year would probably double the cost per cubic yard excavated. Thus, in the author's opinion, the probable cost per cubic yard would be about $1.20 for a machine similar to the *Dérocheuse*, which could remove about 20,000 cu. yds. of average rock in a year, at a cost of about $24,000 per annum. This estimate does not include the transport of the broken rock in barges, nor the depreciation, interest, and insurance of the plant.

The hot season of the year was far from being favorable to the energy or perseverance usually necessary for the successful application and improvement of any new kind of machine, as the temperature, even at midnight, was often above 100° Fahr.; and the scene of operations was in the desert, far from workshops and other conveniences. But the most prominent disadvantage was the continual interruption of the work to get out of the way of passing vessels, and the care which had to be taken to keep the channel clear. On an average, the length of time during which the machine could work without being interrupted by the traffic was from 40 to 60 minutes at Chalouf, where the actual working time was only from 4 to 10 hours per day. In spite of being obliged to lose the position from five to ten times per day, about 50 cu. yds. were generally excavated each day at Chalouf, without once interfering with the navigation. When working at Port Tewfik, the passing vessels caused much less inconvenience, and the cube excavated each day was generally over 100 cu. yds., working from 8 to 11 hours per day.

In the preliminary experiments on land in 1886, much difficulty was experienced in making points for the cutters, which would break hard rock, and yet keep always sharp; and almost a year elapsed before this detail was satisfactorily settled. The angle given to the cutting edge of the rams, when new, was about 60° (Fig. 7). In the soft rock at Port Tewfik, after some 50,000 blows, the angle of the wedge-shaped points of the cutters had become about 70° instead of 60°. The same rams, after they had worked for some time on the hard rock at Chalouf, became sharper, having cutting edges with an angle of from 43° to 45°; and this angle was found to remain constant. The cutters, accordingly, gradually become sharpened automatically to an angle suitable for a special rock, and do not require to be sharpened by mechanical means. The secret of this peculiarity is that the points are hard inside and soft outside, so that they wear sharper on a hard substance in much the same way as a rodent's tooth; and practically the rams do not wear. They, however, require to be of greater section than those used in the *Dérocheuse*, as the vibration there necessitated the reduction of the drop of the cutters to about 6 ft.: whereas, with stouter cutters, a greater fall, and consequently more effect, would have been obtained.

Perhaps, if the rams had been put on a separate barge, and débris removed by a separate dredger when convenient, the expense would have been less than with a combined machine. However, under the special circumstances in Egypt, it was necessary for many reasons to have the machine as it is. Although the dredging machinery was idle at Chalouf while rock-cutting was going on, still little or no time was lost, as, when the barge was loaded, it generally took half a day for her to go to the emptying ground and come back, during which time sufficient rock could be broken to start dredging again when the barge returned. Again, the rock on the canal often occurs in small patches, which must be found by the buckets, so that it is more convenient to have one universal machine which can work in all depths, and finish any one spot before leaving it. Besides, it would be inconvenient, owing to the traffic, to have floating plant divided into several parts.

When tried in the Western Tidal Harbor of the James Watt Dock, Greenock, on hard rock mixed with quartz, before going to Egypt, the *Dérocheuse* averaged over 20 cu. yds. per hour's work, not requiring to leave a given section behind her. But during the work on the canal, the required section and depth had to be carefully attained; and any projection left had always to be corrected before proceeding. It was, therefore, to be expected that, in a definite work, the output would be less than when the object in view was to lift the maximum amount possible. However, in rock with horizontal stratification, a greater cube per hour could be sufficiently broken up for dredging than in Egypt, where the rock was devoid of stratifications. Some of the blocks broken off in the early part of the work at Chalouf measured 10 to 11 ft. in the direction of the thickness of the bed. Some of these blocks weighed 12 to 15 tons; and they were put ashore with a floating crane. For convenience of transport, holes were made in them, and they were blasted, several blasts being required to reduce them sufficiently. The stone is so hard that the holes, 1½ in. in diameter, could only be made ½ in. deep per hour's work of three powerful Arabs; and the tool broke constantly, although made of suitable steel. This illustrates how tedious and costly it would have been to remove the Chalouf rock by explosives.

To remove a difficulty experienced in Egypt, an automatic catch was designed, which will greatly facilitate the working of the rams on to the chain after a blow has been delivered. When working in rough water, the bell-mouth of the counterbalance weight can be prolonged in the form of a tube, enclosing the head of the ram, so that it will attach itself almost automatically to the hoisting-chain after a blow. When no great variety of depth has to be worked in, the framing supporting the pulleys for hoisting the cutters can be made considerably lower than in the *Dérocheuse*, which had to break and dredge rock from 10 to 40 ft. below the water-line; and the extensive mechanism for traversing the cutters fore and aft would, except in special circumstances, be quite unnecessary. In fact, in most cases a more simple machine than the *Dérocheuse* would be suitable. The dredging-engine could, when not working the buckets, drive the hydraulic pumps; or the propelling engine could be used for this purpose. The only other engine necessary on board, in many cases, would be one to hoist the ladders; so that, when not required to be universal, a combined rock-cutter and dredger need not be a complicated apparatus. For general purposes, independent rock-cutting barges may be more convenient and economical. After a little practice, the men working the cutters know exactly what is going on below the surface. With cutters graduated to show the depth of immersion, no difficulty is experienced in preparing the rock to any required section, in such a way that a dredger following can remove the débris without meeting isolated peaks or unwieldy blocks. An essential point in the work in Egypt was the certainty with which any desired number of blows could be delivered on the same spot, owing to the machine having a pivot-pile to keep it exactly in position. With the light cutters used, it was generally necessary to give a number of blows on the same spot to attain the depth required. The author is of opinion that heavier cutters should be employed, so that one blow might generally suffice to do the required work, as this would be more convenient in subaqueous excavations. The Chalouf rock could be fractured by a blow which the author estimated at 5 tons pressure per square inch; but in order to crush the rock to ballast size, a blow having a pressure of about 7 tons per square inch was necessary. A heavy weight with a moderate drop effects more than a light weight with a high fall. Where navigation necessitates the frequent moving of the machine, as at Chalouf, a pivot is of great use for shore work. The centre of the pivot can be set off with a taut wire from a parallel on shore, and squared to the point abandoned, and then lowered in from 3 to 5 minutes; but to find the position again by trial with the cutters would often cause waste of time.

At the end of the work in Egypt, the 18 cutters remaining were apparently in as good condition as when new. The two broken cutters, mentioned in the expenditure table, gave way in the early part of the work at Chalouf; but the remaining cutters delivered 10 to 20 times as many blows as the two that broke without suffering. One of the cutters broken was 42 ft. long, and 4¼ tons in weight, and it fractured 8 ft. from the upper end. The other, of similar length, 3¾ tons weight, broke 16 ft. from the point. There is no danger to the men in the breaking of a cutter, as they stand above the heads of the cutters. About three or four hours were required to replace a cutter. In the author's opinion, the fracture of these two cutters, which occurred soon after starting work in the shallow water at Chalouf, was owing to the shallowness of the water. The thin cutters, suitable for working in depths of 38 ft. when used in 9 to 12 ft. of water, were subject to severe vibrations, as the guide had to be kept at the water-line to provide for the deep water alongside the rock. When working in deep water, the vibration is of less consequence; but for all depths stout cutters should be used. If they require to be long at the same time, the weight may be increased to 6, 8, or 10 tons, so that a good stiff section may be had. The cutters of the *Dérocheuse* were 8½ to 9 ins. square.

The foregoing remarks show how useful, in the enlargement of DE LESSEPS' great work, the application of rock-cutting rams has proved; and the author considers that the principle can be adapted to suit other works with equal advantage.

Specifications for Brush Dykes.

The following specifications were prepared by Col. WM. P. CRAIGHILL, U. S. Engineer Office, Richmond, Va., for building about 5,800 ft. of brush dykes in the James River, Va. The proposals for the work were opened Oct. 8.

The dykes are to be built in water of various depths from 0 to 16 ft. at low tide. Mean rise and fall of tide is equal to 3½ ft. One dyke is to be approximately parallel to the shore; others connect this with the shore. There are to be four methods of construction, designated Styles *A*, *B*, *C*, and *D*.

Style A.—A row of piles is to be driven in the direction of the dyke at a distance of 8 ft. from centre to centre. The piles are to be of pine, not less than 8 ins. under the bark at the small end, and not less than 35 ft. long, of uniform taper, with a maximum variation of 3 ins. out of line in their total length, live timber, free from wind shakes and objectionable knots. They must be sawed butt square and sharpened, before being driven. They are to be driven until their tops are 8 ft. above ordinary high tide, then sawed off true to a height of 7 ft. above high tide. If the pile cannot be driven to this depth by a 2,000 lb. hammer falling 10 ft., sinking the pile only 5 ins. on the last 5 blows, or its equivalent in mechanical energy, the contractor will be allowed to cut the pile off at the required height. Pile heads must not be split in driving; if there is danger of this, the pile head must be banded. Parallel to this first row and distant from it 6 ft., a second row of piles is to be driven in a similar manner. In between these piles, at right angles to the current, a layer of brush 30 ft. wide is to be placed. Any live timber will answer as brush. The bottom layers, however, must be of small trees or saplings, of sufficient length to be tied in sections together and laid projecting 15 ft. from the outside row of piles. Crosswise to the bottom layer, a tier of brush is to be built up in between the two rows of piles, and carried to the top of the piles, that is, 7 ft. above mean high tide. The bottom layer of brush must be at least 3 ft. in thickness, and be weighted down with stone or gravel, not less than 2 tons to the running foot of dyke. When the brush has all been put in place, and packed, the piles must be tied together transversely and longitudinally with galvanized iron wire of a size not less than No. 12, American gauge, each set having at least 12 strands of wire, *i. e.*, 6 on each side.

Style B.—Is to be same as Style *A*, omitting the bottom on crosswise brush and the weighting down with stone or gravel.

Style C.—Is to be the same as Style *B* except that the piles are only to be 25 ft. long.

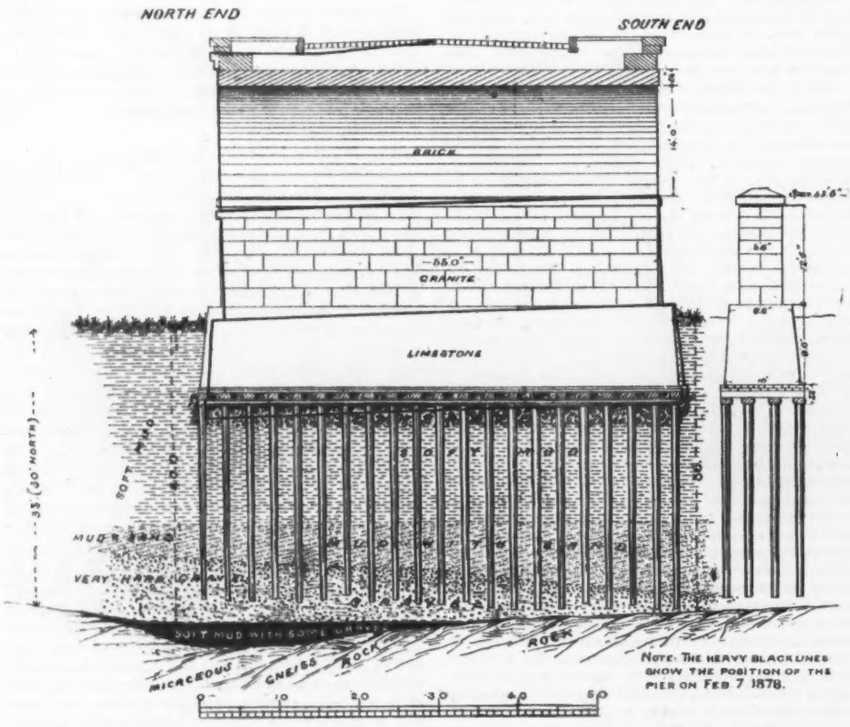
Style D.—This style of dyke is only to be used where the bottom is so rocky that piles cannot be driven to a sufficient depth to hold; and is to be built as follows: Three rows of logs are to be laid for the bottom at a distance of 10 ft. apart. Any live timber will answer as logs, so that it be at least 25 ft. long, and 8 ins. under the bark at the small end. These rows of logs are to be laid parallel to the current. Where the logs in any row lap one another, they are to be tied together with three strands of No. 12 galvanized iron wire. Crosswise to these logs, and distant every 3 ft. apart, binding poles (not less than 4 ins. under the bark at the small end) are to be laid and fastened to the logs by two strands of the No. 12 galvanized wire. Crosswise to the binding poles (that is, parallel to the bottom row of logs) brush is to be put on in layers until the entire mass is 3 ft. thick. New binding poles are now to be laid on crossways to the brush every 2 ft. apart as before, and are to be

tied to the underneath binding poles at every intersection with the bottom logs, and half way in between. When the second set of binding poles has been fastened, another layer of brush 3 ft. thick is to be put on top of them until it is 3 ft. thick also, and a new set of binding poles is then to be laid over, and so on, until the height of the dyke is sufficient to come up even with the surface of low water. The dyke is then to be sunk by means of heavy material, either stone or gravel. After the dyke has been sunk in place, it is to be further consolidated by putting on 2 tons of hard material to every running foot of the dyke.

The style of dyke to be used at the various points will be decided by the engineer in charge, as required by the character of the bottom.

A Lesson in Pile-Driving.

In an editorial on "Safe Loads for Piles," in the present issue, mention is made of the failure of one of the arch-piers under the western approach to the South St. Bridge in Philadelphia some years ago. To avoid going into detail in our editorial, and because the accident is in itself a wholesome lesson to young engineers, we here reproduce the illustrations and an abstract of the original description, as given in the Proceedings of the American Society of Civil Engineers for 1878.



Pier in West Approach of South St. Bridge, Philadelphia, Showing Sinking of Piles.

The illustration sufficiently shows the general dimensions of the pier and its foundation, and it is only necessary to add that the failing pier was one in a series supporting arches which were each 43 ft. 6 in. span and 14 ft. rise. The pile-driving was done in 1870, and the arch work completed some time in 1873. The approach fell on Feb. 10, 1878, as a result of the sinking of some of the piles under one of the piers, as shown in the cut. The masonry of foundation, pier, and arch was exceptionally good, blasting being resorted to in the removal of the wreck.

The ground underlying this approach was an alluvial deposit of soft mud and sand interstratified with deposits of very hard gravel, the latter varying from a few inches to several feet in thickness. The entire area was flooded at high tide in the Schuykill River. For "financial reasons," no exploration of this bottom material was possible other than could be made by a pointed iron rod, screwed down by the united effort of four men working on a cross-bar. With this apparatus, it was not possible to penetrate any considerable depth into the harder gravel strata.

As this exploration was by no means trustworthy, the engineer in charge deemed it only wise to do some exceptionally hard pile-driving (he inherited the plan of pile foundations), and to make up for deficient exploration by this hard driving and the number of piles used. The first result of this determination was to find that the piles of pine and oak originally supplied would shatter and broom as soon as "hard bottom" was struck under the blows of a 2,000-lb. hammer in a pile-driver with a maximum drop of 32 ft. As there was no telling how thick the resisting stratum was and how much mud was below it, piles of a stronger material were sought, and finally found in a Nova Scotia spruce pine. In this pine the timber is very tough, and it is filled with knots at short intervals which seemed to run almost to the heart of the stick; it was almost impossible to split it, even in short sections, and in many cases the bands and shoes used in the former pile timber were found unnecessary, as these piles did not broom. As a proof of the qualities of this slow-growth pine, it may be mentioned that a "follower," 14 ft. long and 13 in. diameter, which was banded at each end, and had received 3,000 blows (estimated) from a 2,000-lb. hammer under various heights of drop, was finally sawed in two longitudinally and planed. The disturbance in the fibre did not extend more than about 1 in. below the top band; the remainder of the "follower" showed absolutely no signs of shattering or disturbance of fibre.

At the particular pier illustrated, these piles struck a stratum of this hard gravel, and by persistent effort they were driven into it for a considerable distance. In this case, there was no evidence, when the wreck was cleared away, that the piles had in any manner been injured by the force of the blows; but the hard driving was unfortunate, and doubtless the cause of the disaster. The section shown on the cut was that found by sinking test wells after the damage was done. The "very hard gravel" stratum was thick enough to have held the structure safely, had the piles been stopped at its surface; but by driving them half through this gravel the piles seem finally to have broken through it (settlement was not evident until some time long after the completion of the masonry), and the soft mud pocket below the gravel did the rest. The thick mud stratum, from the surface down, was impervious to water, and one theory of the engineer in charge was that this mud, by its friction on the surface of the piles, as originally driven, may have had a considerable but unknown supporting value. As the meadow surface was flooded by the tide twice each day, it would seem probable that this water gradually found its way down around the piles, destroyed this frictional value in time, and then by throwing *all* the load on the top of the pile, overcame the resistance of the lower part of the gravel stratum and punched it out into the mud below. This is merely a theory, but it is otherwise difficult to account for the gravel having safely carried the load of the structure for some years before failing; though it is also possible that a long-applied quiescent load may have had the same effect.

Formulæ for Safe Bearing Load of Piles.

The following is a reprint of the more essential parts of an editorial published under the above title in our issue of Dec. 28, 1888, in which we recommended, for reasons here abstracted, the following simple formula for the safe bearing load on piles, viz.:

$$\text{Safe load} = \frac{2\,(\text{Wt. hammer} \times \text{fall in ft.})}{\text{last penetration in ins.} + 1}$$

It appears to us advisable to reprint the substance of the article in connection with a further discussion of the same subject which appears on our editorial page, in order that the entire discussion may be more readily followed.

After stating that there are many trestle piles driven to a last penetration of as much as 3 to 4 ins., which yet stand pretty well, and that adjacent piles in a foundation will often differ in last penetration as much as from 1¼ to 2½ ins., the article continues:

That pile driving and pile loading must forever remain an empirical art, defying close analysis by formula, is indicated in another way by the enormous difference which the character of the blow and the condition of the top of the pile makes in the penetration. In the mud of the Hudson River, it is almost impossible to drive a pile by blows at all, and most of those which are driven are "pulled" down from a scow by placing part of the weight of the scow as an insistent weight on it, beneath which it gradually sinks. When the load is taken off, these piles remain solid under any load which does not approach too closely to that by which they were driven; but if originally driven by hammers, they cause no end of trouble by continuous slow settlement, and some of the ferry slips of Jersey City and Hoboken are only kept in place by arrangements for constant readjustment of the pile support, for which there are ingenious permanent arrangements.

How great a difference the condition of the head of the pile makes in the penetration under the last blow, and hence in the resisting power, is indicated strikingly in some figures given in a paper by DON J. WHITTEMORE,* showing the gain in penetration by cutting off the broomed end of a green Norway pine pile, driven by a 2,800-lb. Nasmyth hammer falling 36 ins.: [The number of blows to drive 1 ft. decreased from 684 to 275 and from 825 to 213.]

According to any one of the established formulæ for pile-driving, the ultimate load which the pile would sustain would have been three or four times as much, had driving stopped just before adzing off, as if it had stopped just after; yet no reasonable man can doubt that its real resisting capacity was much less.

In order to show what various engineers have evolved from their inner consciousness as about the proper thing for piles, we give in the accompanying large table a full abstract of all the leading formulæ from the simplest to the most complex, abstracted from a valuable paper on the subject by Mr. RUDOLPH HERING which every engineer should have, published by us in 1887.† The last nine columns of the table we change from the form given by Mr. HERING to a form giving the *relative* resistance indicated for piles driven under varying conditions, taking as a unit the resistance of a pile driven by a 2,000 lb. hammer falling 30 ft. In all cases the last penetration is taken as 0.1 ft. It is evident that the *ratio* of ultimate loads under various weights of hammer and falls is of more importance than the absolute amount, since there must be a certain factor of safety any way; and if these rates of all formulæ be the same we shall obtain the same safe load from any one of them simply by varying the value of the coefficient F common to all the formulæ.

*Trans. Am. Soc. C. E., Vol. XII., 1883, p. 442.

†Bearing Piles: Formulæ for the Sustaining Power, Size and Distribution in any Foundation. By RUDOLPH HERING, C. E. Second edition ENGINEERING NEWS Popular Library. 25 cts.

As respects the effect of different hammer falls, taking 30 ft. fall in each case as unity, we have:

	2,000-lb. hammer 10 ft. fall.	2,000-lb. hammer 5 ft. fall.	1,000-lb. hammer 10 ft. fall.	1,000-lb. hammer 5 ft. fall.	500-lb. hammer 10 ft. fall.	500-lb. hammer 5 ft. fall.
Simplest formula	.333	.167	.333	.167	.538	.167
Most complex	.333 to .398	.159 to .208	.278 to .404	.140 to .232	.520 to .533	.260 to .064
Trautwine	.695	.550	.695	.550	.695	.550

McALPINE'S, RONDELET'S, and RANKINE & MASON'S formulæ are neglected, as not really intended to be general for all conditions. The simplest formula is the first one given in the large table, SANDERS', viz.:

$$L = F\frac{wh}{s}$$

Now, examining this table, is there the slightest evidence that the more complex formula approaches any more nearly to the true ratio of experience than the simpler form, which gives the resistance as inverse to the fall, penetration being equal? If there is, we fail to see it. These complex formulæ dodge all around the simpler form, sometimes larger, sometimes smaller; with a tendency, however, toward the extreme embodied in TRAUTWINE'S formula (which differs markedly from all others of note) in attaching little weight to height of fall. To a certain extent, we know this to be justified. A 30-ft. fall will hardly triple the resistance power due to a 10-ft. fall; but will any one believe that a 10-ft. fall pile may properly be trusted with 70 per cent. of the load placed on a 30-ft. fall pile? The most rigorous theoretical analyses, as embodied in such formulæ as REDTENBACHER'S and WEISBACH'S, do not differ materially from the directly inverse ratio; and, bearing in mind that the high falls are rather the unit from which we measure, and that the only effect of complexity is to increase the loads placed on small-fall piles, we fail to see anything to be gained by it.

As respects the effect of weight of hammer, we have the following comparison, taking the 2,000 lb. hammer as unity, and other conditions as above:

	30 ft. falls 1,000 lb. hammer	30 ft. falls 500 lb. hammer	10 ft. falls 1,000 lb. hammer	10 ft. falls 500 lb. hammer	5 ft. falls 1,000 lb. hammer	5 ft. falls 500 lb. hammer
Simplest formula	.500	.250	.500	.250	.500	.250
Most complex	.417 to .695	.157 to .307	.417 to .693	.417 to .693	.417 to .693	.417 to .693
Trautwine	.500	.250	.500	.250	.500	.250
Nystrom	.348	.098	.347	.098	.363	.102

Nystrom is given separately, as very exceptional and plainly inadmissible.

Here all the formulæ agree in assigning the same ratio of effect to hammers of varying weights under varying falls; but is there any reason apparent why, the fall being constant, the effect of the blow should vary materially from being directly as the weight of the hammer? Plainly not to the theorists as a class, since they vary on each side of this. If anything, the lighter hammer should have somewhat less than proportionate effect, yet the most of the complex formulæ give the effect of the lighter hammer as somewhat greater than that of the heavier ones in proportion, apparently from purely mathematical reasoning: "If it does not conform with the facts, so much the worse for the facts." Within the moderate limits of variation which occur in practice, we see no evidence of any theoretical or practical gain by varying from the simple assumption that the resisting power varies directly as the weight of the hammer, all other things being equal.

The effect of the factor s (penetration under last blow) in the various formulæ, we have not analyzed, since Mr. HERING did not enable us to do so easily by computing a table of ultimate loads for various values of s. In most of the formulæ L is inversely as s, which plainly cannot be correct, as when $s = 0$, L becomes infinitely great. To avoid this absurdity, TRAUTWINE adds to s the constant 1 in., which seems to us the true principle. Others have extremely complex forms, the effect for which can only be determined by trial.

The form of equation which, it seems to us, in view of the preceding and some following facts, is the proper one and the only one likely to be useful in practice is:

$$\text{Safe Load } L = F\frac{wh}{s+c}$$

in which w = weight of hammer, h = fall, s = last penetration, c = some constant addition to s, preferably 1 in. and F = a constant determined from experience. This in the first place conforms closely to the theory of pile-driving. We distrust all formulæ which, like TRAUTWINE'S $\sqrt[3]{h}$, are not only unsupported by theory, but in direct and complete antagonism to it. The hammer in falling stores in itself a certain force, which is the driving force, measured by wh. By this force the pile is moved a certain distance s, and barring the energy wasted in brooming the pile and heating pile and hammer, it is mathematically certain that the *average* resistance against which the pile moves through s is measured by $\frac{wh}{s}$ from which it is a simple inference that the ultimate load shall be in some fairly close ratio thereto.

Such conclusion is modified by several theoretical and practical considerations, the first of which is that the resistance is very unequal at the beginning and end of the motion s, being increased at the beginning by the pile's inertia and decreased at the end by the pile's *vis viva*. It is on this account that heavy hammers with small falls are more effective than light hammers with high falls; they attempt to communicate too great and too sudden a velocity to the pile. And it is on this account that the weight, area, and length of pile, modulus of elasticity, and what not, enter into formulæ seeking to be theoretically exact. The friction is also much greater at first than after the pile is started, and the rapidity of the blows has a great effect which defies analysis; quick blows being vastly more effective than slower ones, because leaving no time for the ground to settle and stiffen around the pile between the blows. This fact, however, tends to make the sustaining power greater than that exerted at the end of the last blow, and so to compensate more or less for other sources of error.

If we assume that the ultimate load for a pile = average resistance during last blow, or $\frac{wh}{s}$, we have for a 30-ft. fall of a 2,000-lb. hammer, with $s = 0.1$ ft.,

$$L' = \frac{30 \times 2{,}000}{0.1} = 600{,}000 \text{ lbs.}$$

as in the first (SANDERS') equation of the large table.

If we give this equation the form suggested above, making $c = 1$ in. or 0.0833 ft., as in TRAUTWINE'S formula, we have for ultimate load:

$$L' = \frac{30 \times 2{,}000}{0.1833} = 327{,}000 \text{ lbs.}$$

In the large table it will be seen that the more elaborate formulæ differ much more from each other than they do from this, and comparing it with the observed ultimate load for five different piles, as quoted in Mr. TRAUTWINE'S letter above, we have:

Pile No.	Actual ult. load lbs.	$L' = \frac{wh}{s}$ Ratio, (actual = 1.)	$L = \frac{wh}{s+0.083}$ Ratio (actual = 1.0)
1	60,500	145,600 2.4	39,700 0.66
2	14,600	38,400 2.6	36,300 2.49
3	224,000	1,612,800 7.2	537,000 2.40
4	91,800	1,584,000 17.2	527,000 5.75
5	75,000	440,800 5.8	264,000 3.53

The observed load for pile 1, with a 910-lb. hammer falling 5 ft. and ¾ in. penetration, is disproportionately great by either formula; but the extreme case of pile 2 with 18-in. penetration is much less anomalous in the last, which likewise seems to us to give better (because more uniform) results than Mr. TRAUTWINE'S formula. The average factor may be taken as somewhat under 4, and the indications from the above and many other facts seem to us decided that a factor of safety of 6 will cover adequately the weakest piles driven under fairly normal conditions, while not falling in any case sensibly below the loads warranted by good practice. Taking likewise the last penetration in inches instead of feet, this gives to the equation for safe load the simple form:

$$L = \frac{2wh}{s+1}.$$

Comparing this with the safe loads given by either formula, most of them extremely complex, we have the following:

Safe Loads for Piles sinking 0.1 ft. under Various Blows, according to Various Authorities.

	30 ft. fall of 2,000-lb. hammer	5 ft. fall of 500-lb. hammer
Sanders	200,000 to 75,000	8,333 to 3,125
Mason	120,000	3,125
Trautwine	84,900 to 14,150	11,680 to 1,950
McAlpine	68,200	(negative)
Rankine & Mason	28,800	28,800
Rankine	262,000 to 52,180	12,416 to 2,483
Weisbach	45,265 to 4,526	2,467 to 267
Redtenbacher	98,810 to 65,870	3,104 to 2,070
Brix & Becker	96,000 to 64,000	6,250 to 4,167
Weisbach	48,250 to 4,825	1,350 to 136
Nystrom	64,000	1,040
Brix & Becker	24,000 to 16,000	1,562 to 1,042
By Formula $L = \frac{2wh}{s+1}$	54,545	2,273

When such extreme variations are allowed as in some of these cases, a formula becomes worse than useless, as also when such excessive co-efficients of safety as WEISBACK'S (0.1 to 0.01) are assumed. There are no reasons why there should be any very great difference in factor for different soils; penetration, hammer, and fall being the same. We question if under these conditions greater differences than about 2 to 1 ever have been or will be observed in however different soils, assuming always that the pile does penetrate, and with some approximate regularity under the later blows. It appears to us, therefore, and we suggest to the profession as a result of no little examination of the facts as to pile driving at various times, that there is no better or safer formula than that above given for the *safe working load for piles under all ordinary conditions, to be reduced under exceptional conditions* (as notably with irregular penetration) *but never exceeded* unless pile is known to rest on rock and act as a column:

$$L = \frac{2wh}{s+1}$$

in which L = the safe load in lbs., tons, or other unit-W = wt. of hammer in the same unit of weight; h = fall in feet, and s = penetration under the last blow in inches, assumed to be sensible and at an approximately uniform rate.

If there are any facts on record tending to invalidate this formula, or to indicate that another would be better, we should be glad to know them. It is at least consistent, and cannot lead astray, as the miscellaneous assortment in our large table is very liable to do.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—Regular meeting, Oct. 16. Vice-President J. J. R. CROES presiding. The paper of the evening was entitled "Cast-Iron: Strength, Resilience, Tests, and Specifications," by Mr. J. B. JOHNSON, M. Am. Soc. C. E. Prof. JOHNSON in this interesting paper gave the results of some late experiments at the Washington University Testing Laboratory. Space forbids following out the detail of these experiments and the remarkable, and in some cases unexpected, behavior of the metal under test. But as one result the author was convinced that no specifications should allow a lower limit in tensile strength than 20,000 lbs. per sq. in. and he believed 25,000 lbs. could be commercially obtained. He thought that in the modern refinement of tests for wrought iron and steel, cast iron had been too much neglected, and he hoped that engineers would unite upon a standard specification that would at once improve upon the present practice of foundries by educating the foundrymen. He believed it was a bad practice to specify mixtures when it was the product only that was desired. Prof. JOHNSON concluded his paper by appending a set of specifications for cast iron, in the hope that it would provoke discussion of this important question. The paper was followed by Mr. GEORGE A. JUST, engineer of the Jackson Iron Works, with a brief description of some late tests of architectural cast iron, with an exhibition of the test specimens. Mr. BEDG, of the firm of J. C. Cady & Co.'s Architects, believed, as did the previous speaker, that Prof. JOHNSON'S limit of 20,000 lbs. was too high, 15,000 lbs. seeming sufficient for all useful purposes and more certain in practice. Several items in the proposed specifications were also objected to from the builders' standpoint, and other specification items were proposed as essential. At the next meeting Mr. C. E. EMERY will read a paper upon the Forth Bridge and other points of interest visited in the course of the late engineers' visit to England. A paper by Mr. J. B. WESTON on "The Flow of Water in Pipes" is also promised at an early date.

Engineers' Club of Philadelphia.—Record of regular meeting, Oct. 5, 1889. Vice-President ARTHUR BEARDSLEY in the chair; 20 members and 2 visitors present. Mr. GEO. N. BELL presented a paper upon "The Development of Suburban Property," in which it is clearly shown that this cannot be done to the best advantage without the assistance of systematic and intelligent engineering and landscape gardening. The paper and kindred subjects were discussed by Prof. ARTHUR BEARDSLEY and Messrs. T. M. CLEEMANN and HOWARD MURPHY.

HOWARD MURPHY,
Secretary and Treasurer.

The Denver Society of Civil Engineers and Architects.—Denver, Oct. 8, 1889.—Meeting called to order by President NETTLETON, with 14 members and 2 visitors present. Mr. FOLLETT resigned the offices of Secretary and Treasurer, and notice was given that the vacancies would be filled at the next regular meeting.

Mr. JACKSON, Architect, and now Building Inspector of Denver, read the larger portion of the new ordinance relating to the construction of building. The ordinance has now passed the Council, and is awaiting the action of the supervisor to become a law. It is quite voluminous and carefully got up. Among the main points covered are the division of the city into two fire districts, one covering the business portion of the city, and the other the residences. Parties must defend their foundations to a depth of 10 ft. 6 ins., on property lines; foundations for residences must be at least 2 ft. 6 ins. deep; 90 days are allowed for the use of one-third of the street in front of property; the business wall in blocks to end in less than 13-in. wall; no wooden posts in business blocks over 20 ft. high; all tenement houses, flats, and stores to be provided with scuttle in roof fastened inside, but not locked. The Society endorsed the ordinance and recommended a new ordinance regulating the manufacture and quality of brick.

GEO. H. ANGELL,
Secretary pro tem.

American Institute of Mining Engineers.—The 55th meeting of the Society was held at Ottawa, Canada, during the first week in October. Among the papers presented was one by Dr. ELLS, of the Geological Survey, on "The Mining Industries of Eastern Canada." Mr. ASHBURNER, of Pittsburg, contributed a paper entitled "Natural Gas Explorations in the Oi-

tario Peninsula." Mr. ASHBURNER expressed the opinion that they would never find enough gas in the peninsula to be transported in pipes to any considerable distance, although enough might be discovered to supply domestic uses in the immediate locality. A discussion ensued as to the origin of natural gas. Mr. THOS. MACFARLANE, Dominion Analyst, inclined to the opinion that it was derived from coal, but Mr. ASHBURNER and Dr. RAYMOND, of New York, thought the majority of the opinions of authorities were that it owed its origin to animal matter. The following biograpical papers were presented: "Biographical Sketch of WM. H. SCRANTON, of Scranton, Pa.," by Dr. RAYMOND; "Biographical Sketch of Dr. GEO. H. COOK, of New Jersey," by Prof. SMOCK, of Albany; "Biographical Sketch of Capt. JONES, of Pittsburg," by Mr. ASHBURNER, of Pittsburg.

State Sanitary Association of New Jersey.—At the annual meeting, to be held at Trenton, N. J., Nov. 15 and 16, a paper will be read by Mr. C. PH. BASSETT, C. E., of Newark, N. J., on the "East Orange Sewage Disposal Works as Compared with Other Methods." The discussion will be opened by Mr. JAMES OWENS, of Montclair. Among the other papers to be presented are "The Drainage of the Passaic Valley," by Dr. G. E. HOWELL, of Morristown; and "The Relation of Conduits to the Healthiness of Water," by Dr. W. K. NEWTON, of Paterson.

New England Railroad Club.—At a regular meeting held on Wednesday, Oct. 9, President RICHARDS occupied the chair, and announced as the subject for discussion at the next meeting "Journals and Journal Bearings," and the subject for discussion at the present meeting, "The Permanent Way and Rolling Stock and their Relation to Each Other," to be opened by Mr. J. N. LAUDER, of the Old Colony Railroad.

Mr. LAUDER.—I think it would be profitable for us to look back twenty years and trace the improvements that have been made in the permanent way and rolling stock of railroads. Twenty-five years ago we had iron rails, the old-fashioned chair, cast or wrought iron; there were no fish-bars, or but very few. We find today that both rolling stock and track have been greatly improved.

I want to say a word with regard to the influence that railway clubs and associations have exerted in bringing about a better state of things in railroad affairs. Twenty-five years ago every railroad was a law unto itself; every man in charge of rolling stock got up his own designs and carried out his own notions. He gauged his wheels, for instance, to suit his ideas, the lateral motion from ¼ to ⅝ in. I think the first association was the Master Mechanics, organized about twenty-one years ago. These questions were taken up, and this want of uniformity in practice was discussed; every one was tenacious of his own ideas and tried to impress them on others; but in the course of time, and through the persistent work of committees, the members of the association were made to see that certain things were right, and variation from them was wrong, and what was right for one railroad must necessarily be right for all. Not that a standard engine or a standard car could be designed that would be all right for all roads; but, as regards the gauge of the tires, the flange and form of the wheel tread, the method of relieving the blows of the wheels on the rails by the interposing of springs and equalizing bars, and many other things, what is right for one road is right for all. Through the efforts of the associations, order has gradually been brought out of chaos, and to-day we have a standard width between flanges of wheels, standard tread, standard diameters of wheel centers, and many other valuable standards.

Soon after the Master Mechanics' Association was formed, the Master Car Builders organized an association, which took up matters pertaining to the cars, as the other had taken up things pertaining to locomotives. They had, perhaps, a wider field to work in in this respect, that cars, especially freight cars, had to run over different roads. That made it necessary to bring about standards in connection with the running gear of freight cars. In the course of time, the interchange of passenger cars was also established, and now substantially all the passenger cars running in the United States have standard running gear.

The Roadmasters have an organization four or five years old, and have done good work thus far. I hope they will make their organization as much of a power in their profession as the Master Car Builders have in theirs. The reports brought out at their conventions will lead to greater uniformity in the construction and maintenance of the permanent way. If a certain section of the rail is the best possible for one road, the safest, and the most economical, and will stand the most hard usage, it seems that it must necessarily be the best possible standard for all the roads, varying only in the matter of weight. I believe there should be a standard rail for each weight, varying perhaps by 10 lbs. If there is a road that a 70-lb. rail is too light for, put on an 80-lb. Ten pounds doesn't add very much to a rail, distributed over 3 ft.

I think it is incumbent upon the engineers and road masters to settle on a standard rail-head, and after years of observation and experiment, it seems to me that we are far enough advanced to-day to have a section of rail designed for these differing weights that shall be a standard for the whole country. Of course, there will be the same trouble in arriving at a standard as there has been in getting standards for our rolling stock. I think it took the Master Car Builders five years of constant labor and effort to adopt the standard axle, but it has proved a great benefit, notwithstanding its defects. I believe the same benefit would result from the adoption of a standard rail section. The Master Mechanics have adopted recently standard driving-wheel centers, which are being rapidly adopted by the different roads, though at first they were greatly opposed by many of them; so that in a few years it will be possible for any tire maker to pile up thousands of tires in his yard, knowing he can sell them, because they are standards, and he can then fill his orders promptly.

If there were a standard of rails, of different weights, it would enable the rail manufacturers in dull times to make them and pile them up, and be ready to fill orders at short notice; and this would also be a great advantage to the railroads, because they would make the manufacturers carry the stock instead of carrying it themselves, as they are now doing with the tires. Now at times a road which cannot wait to have rails manufactured to order will in case of emergency take a rail slightly different from its standard; those rails will get mixed with others, and the fish-bars will not fit, and trouble ensues. I am interested in having a good track, good switches, good frogs, and everything good that pertains to the track, because my rolling stock will stand up and work longer and with less repairs than on a rough track. The Road Masters are interested in the rolling stock in the same way, in having tires well-turned, in having the the right kind of flanges, and everything about the rolling stock in good order. I suppose there are roads in New England and out West that still use the barbarous stub switch, but I don't see why they should when there are other switches so much safer and better and I believe cheaper. I believe the plain point switch is the cheapest that is made to-day, and can be replaced or kept in order with less labor than any other switch. I want to declare myself against the stub switch; the old Tyler safety attachment used with it I believe to be of little use with our heavy trains, so that practically the stub switch of to-day is without any safety appliance. Then again, its whole safety when set depends upon the strength of the switch rod, the strength of the appliance for moving it, and the solidity with which it is fastened to the tie timbers,—a reliance altogether too uncertain. I think the Road Masters should agitate the matter until they get something better universally adopted.

Mr. W. F. ELLIS, Secretary of the New England Roadmasters' Association, then read the following paper:

In this discussion I will try to confine myself to what should be used at the present time to maintain the Permanent Way on New England Railways.

The rail to be used should conform to the resolution passed in 1888 at the meeting of the N. E. Road Masters' Association.

Resolved, 1. That the weight of steel rails should never be less than 72 lbs. per yd., but as much heavier as we can secure.

2. That the best form of rail section is, as to size 4 1-2 ins. high by 5 ins. base, and the form to fit the flange of the wheel as nearly as practicable with no sharp corners, and top of rail flat enough to give at least 1 1-4 ins. for wheel friction.

3. That rails should be curved before laying on any curve that is sharper than 2°.

4. To be curved with some form of machine that shall not produce a sudden concussion on the rail.

5. That a suspended joint is best.

6. That the broken joint is preferable, all points considered.

To this resolution I would add,—The form of rail section should be such as to allow in the process of rolling the metal in the rail head to be nearly of the same temperature as that in the web and base, thus insuring the same hardness, and freedom from flaws. The gauge of the track to be 4-ft. 8 1-2 ins. The angle bar joint to be used, not over 24 ins. long, of such weight and shape as no tto break, and to give proper support to the rail-ends. The ties to be not less than 8 ft. long, 7 ins. thick, with face of at least 7 ins., using at least 2,800 to the mile.

The split switch with the automatic stand, with a flexible tie or switch rod, to be used, not only on the main track, but in the renewal of side-track switches where there is any amount of switching done, and at such side track switches where a derailment from an open non-safety automatic switch would stop the traffic on the main track. I would also recommend a guard-rail to be used at the points of all split switches where same are not trailing switches.

To use a spring rail frog in all cases except where there is nearly the same wear on each wing of the frog, and in yards, where the rigid rail frog should be used.

The guard rail at frogs to be the standard as adopted at the 1887 meeting of the N. E. Road Masters' Association:

Guard Rails at Frogs. Voted, That it is the sense of this convention that the best form of guard rails at frogs is the following: Length, 12 to 15 ft., curved a true curve with a radius of 150 or 175 ft., center of guard rail set 6 ins. ahead of point of frog, securely spiked, and fastened with three braces, one opposite the point of frog, and one on either side.

To this I would add:—This would be a correct guard-rail for rigid rail frogs, but for a spring-rail frog the guard-rail would have to be parallel to the main rail with a flangeway of 1¾-ins. for at least 9 ft. of its length at center of same, and well braced its entire length.

The flange-way at frogs and guard-rails to be as adopted at the 1884 meeting of the N. E. Road Masters' Association:

Resolved, That the width of the flange-way between the point and wing rail of the frog and between the guard-rail and main rail, should be 1¾ ins.; and as per the guard-rail gauge Fig. 8 of Master Car Builders' Report at the 1888 meeting, 4 ft. 5 ins. by 1¾ in. flangeways.

The tangents should be aligned once in ten years, and the curves once in five years, to be corrected by the transit.

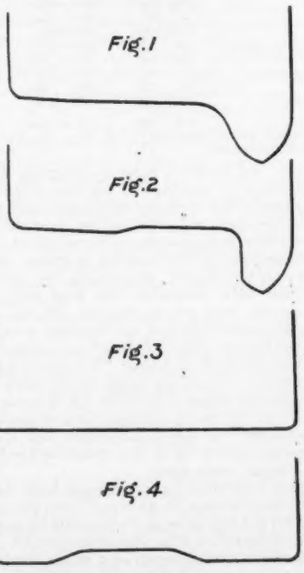
The elevation on curves to be such as speed of trains and traffic demand.

The ballast to be of broken stone, when circumstances permit, or good gravel, with proper drainage to same. At least once in five years in the surfacing of the track there should be a light raising of the same. All highway crossing should be carefully cleaned out each year, renewing with fresh ballast.

Culverts to be of stone, and covered with ballast if possible.

Where arches of stone cannot be built, iron bridges should be used, but calculated to carry with safety, not only the weight of the present rolling stock, but such a proportionate increase in the same as the last ten years' progress has indicated may be needed. With these bridges a floor and guard-rail to be used as recommended at the 1887 meeting of the N. E. Road Masters' Association:

Guard Rails at Bridges with Bridge Floor. Resolved That the ties be 10 ft. long, 8 ins. square, 8 ins. apart, secured in place by a timber 8 x 6 ins. square, gained on to each tie near the outer end, and bolted firmly, an iron guard of railroad iron on the inside of the track rails and 8 ins. from them, and approaching the center of the track at about 30 ft. from the ends of the bridge, and connected together by the old point of a frog; that the long bridge ties for a distance of about 30 ft. be put in on the ground at each end of the bridge and the outside guard-rail be extended on same, spreading at the ends about 3 ft. outside from the main track rail.



Sections of Tread, New and Worn.

To this I would add the use of a re-railing device, and suggest the use of the Bush bolt and nut, or the Davis steel lock spike, in the spiking of the main track rails to prevent creeping.

The labor to be employed to be such as speed of trains and tonnage of road require; to renew the necessary material at the proper time, and when renewed to properly maintain it for the economy of both labor and material.

It is not expected of those in charge of the permanent way and of the rolling stock to have any more men employed than actually needed (and at some seasons of the year there are not enough in their estimation for economy), so that whenever any one of their men is sent away to do other work than what he has been expected to daily perform, the legitimate work is neglected. For instance, there is a derailment through spreading of the rails on the side tracks, through improper or loose guard rails at frogs, improper gauge at frogs and switches, bent axles and broken wheels and journals, wide and narrow gauge cars, improper inspection of cars, and carelessness of train men, which entails a serious loss to the department which has to supply the labor at such derailments, if of frequent occurrence. To prevent the same, the relation of the permanent way department to the rolling

stock department should be of a friendly rather than an antagonistic relation. I will take up only the relation of the form of tread and flange of the wheel, when new and worn, with gauge of same, to the frogs, switches and guard rails of the permanent way. In Fig. 1 of the accompanying sketch I represent the form of the tread and flange as adopted by letter ballot of the Master Car Builders' Association in 1886 (Report 1888, page 155). In Fig. 2 I represent the form of the worn tread and flange which a wheel may come to have before it is rejected for use, by the "Wheel Defect Gauge, M. C. B. S'td., 1887." (Code of Rules, Rep. 1887, p. 183, 184.) In Fig. 3 I represent the form of a 6-in. wide tread of a blind driver of an engine. In Fig. 4 I represent the form of the same blind driver tread when worn so as to make a double flange ¼ in. deep. I would state here (see page 156 M. C. B. Rep. 1888) the standard distance between the backs of the flanges of car wheels is 4 ft. 3⅝ in., as approved by letter ballot in 1883, which gauge was very satisfactory to those in charge of the permanent way department; but a committee in 1885 recommended in the fitting of wheels to axles a variation of ⅛ in. each way from 4 ft. 5½ in. as a maximum gauge, which was also adopted by the association.

Please bear in mind the gauge of track is 4 ft. 8½ in.; gauge of guard rails 4 ft. 5 in., as adopted by both associations, thus allowing ¼ in. leeway or discrepancies in gauge of wheels and guard rails. But in same report for 1888, p. 185, under Code of Rules for Interchange of Cars, we find: "Cars may be refused if their wheels measure less than 4 ft. 5 ins. or more than 4 ft. 5¾ ins. between backs of flanges," thus allowing for no discrepancies in the gauge of guard rails; while the wheels have ¾ in. for variation.

We will now suppose the guard rail and frog are in proper condition and correct gauge, 4 ft. 5 ins., and a train of cars properly inspected as per "Code of Rules" passes through the same. The relation to each other is friendly, and no damage is done. Another train passes in which there is a car or cars that have failed of correct inspection, or are loaded with heavy machinery or bulky freight received from a foreign road without inspection, and the gauge is 4 ft. 4¾ in. or 4 ft. 6 ins.; the relation becomes antagonistic, and mischief commences by an effort to pull the frog to pieces or loosen the guard rail for the permanent way, or in bent axles and broken flanges for the rolling stock; and soon the guard rail will become loosened, as shown in Fig 5.

Now take a car with wheels as shown in Fig. 2, even with correct gauge. The stock rail of the split switches, the wings and points of the frogs are being damaged, with a good chance of a broken flange to the wheel. I ask the question, Is there not a brakeshoe that can to a certain extent keep car wheels from such a condition?

Now, assume an engine with a double flange blind driver, tire 6 ins. wide, only ¼ in. deep flange, as Fig. 4 shows. This will, with the 72-lb. rail section in use on my road, just fit in, and disturb the guard rail but very little, as shown in Fig. 6; yet the frog will suffer; but if the main rail has cut into the tie ¼ in. or has its head worn down ¼ ins., this driver will strike the guard rail as shown in Fig. 7. It also will give the main rail at split switches hard wear as shown in Fig. 8. If the gauge of these blind drivers is less than 4 ft. 5 ins., the guard rails, as well as frogs and switches, will be injured very much more.

Shall the remedy for the same be to give the road-master authority to order into the shops any engines that he catches running over his frogs with double flanges? Or what shall the remedy be? I have failed to find in any report of the Master Car Builders' Association what depth of hollow is allowable before the same should be rejected for use, and I ask for information on that point.

Mr. LAUDER.—Mr. ELLIS asks if there is a brake-shoe that will keep the tires in comparatively good condition, as they are worn away by the rail. There is a brake-shoe, called the Ross shoe, which has a bearing on the flange and on the outer side of the tread of the tire, and has another bearing on the part of the tire which usually comes in contact with the rail. I believe that no engine should be run without a driver brake; and if it is equipped with a driver brake which is used as it should be, the Ross shoe will keep the tire in very much better shape to meet the requirements of a well-fitting tire to the rail, than if it is allowed to run without a brake-shoe.

The other question he asked was, if we have any rule to determine when a driving tire shall be taken off and turned. It would perhaps be as difficult to have a rule for that as for him to have a rule for taking out rails when they are worn to a certain depth or get a hole in them to a certain depth. I suppose a rail or a tire becomes somewhat imperfect after a month's use, but we cannot take our engines in or remove rails every month or every six months. I believe it would be economical for all railroads to turn their tires much oftener than they usually do; but when business is heavy we cannot spare our engines for that purpose. It has always been my aim to keep the tires as true as circumstances will permit, and it is as much for the interest of my department to do so as it is for the interest of the others; because if an engine is allowed to run with its tires too badly worn, it soon goes to pieces, and it must have a correspondingly detrimental effect upon the track.

Mr. ELLIS'S paper shows that the Road Masters' Association is making rapid progress; they are recommending standards, and their recommendations are adopted. The time is coming when the heads of technical departments of railroads will wield much more influence in the management of the roads than they have in the past, because the little roads are getting absorbed into the larger systems, where you have got to have standards in order to have economical operation. The general managers and superintendents have not the time to go into the details of the business, which must be left to the heads of departments, who will have to be bigger men than formerly, and they will occupy much more independent positions than hitherto.

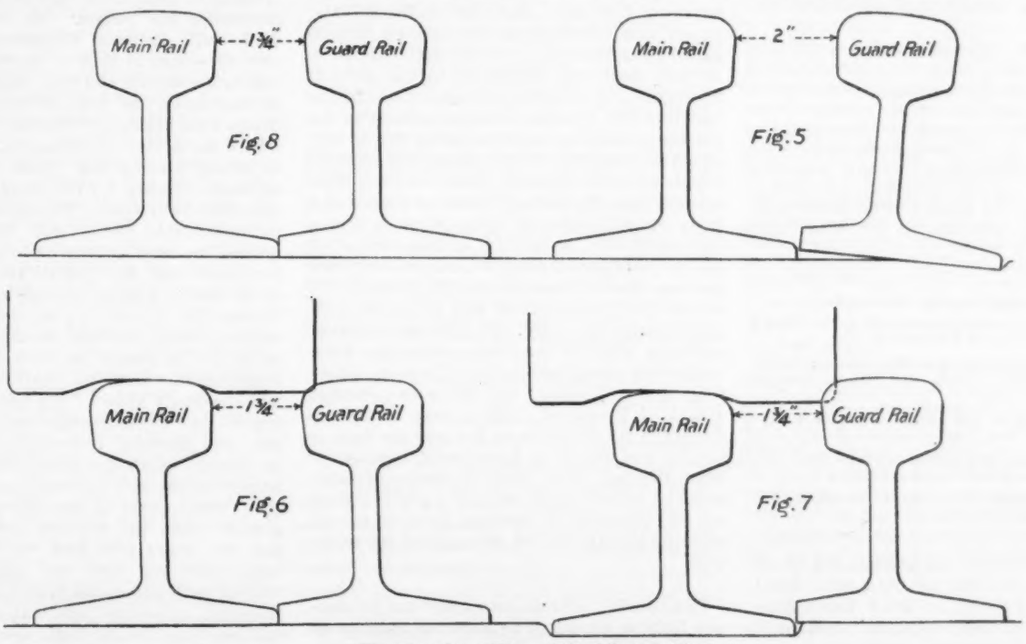
Mr. BISHOP.—The speed at which the trains pass over the track is an important matter. With a high rate of speed, the tendency is for the wheel to press more closely to the outer edge; consequently the rear of the flange passing over the inside rail will come in contact with the wing of the frog, and cause a sudden jerking with a heavy train running fast, 50 or 60 miles an hour. Then a train passes over a track at a speed of 50 miles an hour, and perhaps the engineer will not experience any jerking sensation in going through the frog, will pass it all right. The engineer running at 60 miles an hour will report some trouble with the frog. And then comes a freight train, which is limited to 12 or 15 miles an hour, and that sags over to the inside rail, and then there is another difficulty. There are many things to be taken into account after we have got the standard rail and the standard car. I think the time is coming when the track department will receive more attention, and be considered of the first importance in railroading.

Mr. CLARK.—I have brought with me a piece of rail (showing a piece of rail very badly damaged) that was in the track this morning 10 ft. from the point of a switch. I claim that the tire that will wear a rail into that condition is not a safe tire to run over a split switch. That rail has been in the track 18 months. I believe that the split switch at the point should not get so much damaged as to have to be taken out under less than three years. What is wanted is to adze down the tie in the main track; the rail has been crowded into the tie so as to allow the driver to strike it. I don't think anything does so much damage to a split switch as a hollow double-flange wheel. I don't think this piece of rail is an exceptional case; you can find such rails on roads anywhere, that use split switches, although I think that is the switch for us to use.

Mr. WHITNEY (*Intercolonial Ry.*).—It is very rarely the case with us that we have a tire worn down so that you can call it a double flange tire. We don't allow them to run so long; we have occasionally let them, and had broken crank pins and broken switches. I think it is good economy, not only for the track but for the rolling stock, to keep the ties in good order. It costs something, to be sure, not only to do the work but in the loss of the engines for the time, a considerable item if the road is busy. We never let an engine run to the extent that it is indicated they are run here on some roads. I think it is important to have the shape of the rail and the wheel conform as far as possible.

Prof. SWAIN.—There is a difference of opinion as to what the relation between the wheel and the head of the rail should be, as to whether the rail should fit the wheel or not. I am glad that Mr. LAUDER has advocated so strongly the use of the driver brake, because there is no safety appliance on a railroad which prevents so many accidents as the brake. Of course, to add driver-brakes increases the braking power of the train. I am sorry to see new cars with six-wheel trucks supplied with the old four-wheel brake. It seems to me there should be a brake on every wheel, and I hope the time will come when trains will be so equipped.

Mr. COLEMAN.—It seems to me that we should recognize the fact that the weight of the rails on our roads has not been increased in proportion to the weight of the rolling stock and the speed of the trains. There is more money lost in trying to save money than in any other way, and when people try to save money on a railroad, when they have traffic enough to earn money, by light tracks, they tear their tracks and rolling stock to pieces, so that they have the most expensive track in the world.



The Result of Worn Blind Driver Tires.

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AND
AMERICAN RAILWAY JOURNAL.

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ASSOCIATE EDITORS.
GEO. H. FROST . . . . . BUSINESS MANAGER

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Coming Technical Meetings.

Engineers' Club of Philadelphia, Pa. — Next meeting Nov. 2. Secy., Howard Murphy, 1122 Girard St.

Engineers' Club of Kansas City, Mo.—Next meeting, Nov. 4. Discussion on Sewerage Systems. Secy., Kenneth Allen, 310 Baird Building.

American Society of Civil Engineers, New York.—Next meeting, Nov. 6. Secy., John Bogart, 127 E. 23d St.

Engineers' Society of Western Pennsylvania —Next meeting, Nov. 19. Secy., S. M. Wickersham, Pittsburg, Pa.

Boston Society of Civil Engineers. — Next meeting, Oct. 16. Secy., S. E. Tinkham, City Hall.

WE begin this week the publication of an interesting and valuable paper on the general design of railway shops, by Mr. J. DAVIS BARNETT, Assistant Mechanical Superintendent of the Grand Trunk Railway. Very little is now in print upon this important branch of railway economics, and the numerous badly arranged shop buildings in this country testify to the need for careful study of this matter by those entrusted with the planning of railway structures. Mr. BARNETT has the happy faculty, sadly uncommon among writers on technical subjects, of presenting a great deal of fact in a few words, which makes his paper a readable one to all engineers.

The portion of the paper given this week relates principally to the design of round houses and erecting shops. In the remaining portion of the paper the different shops and their general arrangement are discussed in a very lucid way. Two tables are given, showing the percentage of space occupied by the different buildings at the repair shops of a number of prominent railways. Practice on these matters has been largely haphazard, and such accurate statistics as are here presented are of great value. The paper is also accompanied by plans of the recently erected repair shops of the Maine Central Railroad and of the Chicago & Northwestern shops at Chicago.

WITHIN the week another lineman in this city has met his death, under conditions exceptionally horrible, by the "crossing" of a telegraph wire with an electric light current at some yet unknown point on the circuit. This latest accident, following so closely a number of others from a like cause, has thoroughly awakened New York, and the officials and the press are daily suggesting all manner of protective measures. Some of these suggestions, the result of interviews with high electrical authority, savor strongly of self-interest and the wished-for suppression of rival corporations; and we hear much of the cutting of wires, the pushing of subway construction, and even of the breaking of the monopoly held by the existing construction company.

But the present trouble, and the real danger in existing methods, dates back to the day when the burial of electric wires was earnestly proposed. It was the multiplication of telegraph and telephone wires that first suggested subways; and the then comparatively little used electric light wire was an incidental feature only, in the new plan of wire disposal. But the electric light wires and their powerful currents have also multiplied in these few years past, and while the telegraph and telephone wires were an unmitigated nuisance, many of the electric light wires, as now used, are dangerous to the lives of citizens. The trouble practically lies in the fact that the subways designed primarily for the comparatively harmless wires are of very doubtful efficiency if these dangerous currents are to be passed through them; and it is little wonder that the electric light companies as a body should object to using what is first a monopoly and secondly a system that, after all the expense of removal, may at any time prove so faulty in operation as to seriously obstruct their business, as well as prove even more dangerous to life. The present system of subways was the outcome, originally, of a more than questionable "deal" among notorious city politicians; and while the present Board of Electrical Control may be ever so honest in its intention to perform its duty, it is simply carrying out a makeshift method of wire disposal that, after the waste of large sums of money, must certainly all be ripped up, and replaced by subways more in accord with the actual, modern demands of the situation.

THE electric current necessary for producing light is doubtless a dangerous current in some of its most economical forms of transmission. But the electric light has come to stay, and its wires must be disposed of in such manner and such place and under such regulations that the element of danger will be removed. This cannot be effected, we believe, with any of the forms of subways now in use in this city. New York is peculiarly well adapted, in its elongated and narrow form, for the location of several main longitudinal lines of subways of another and better type,—subways that can be entered by the repairmen, and where wires can be so disposed that every inch will be protected and at the same time be under constant inspection. Thanks to her costly, but efficient, system of sewers, Paris has now the means of so disposing of electrical wires; and London, after an experiment with small subways on the Strand that utterly failed, is contemplating the building of a roomy subway under the same thoroughfare. It will cost money to build ample subways; but all things worth having usually do cost money; and a system that is faulty to start with, and from its method of construction is necessarily short-lived, is dear at any price. If future traffic considerations should interfere with using Broadway for subway purposes, two parallel side locations can be made, and short connecting subways of substantial but cheaper design built to command the whole area now under control, and the whole system made capable of indefinite expansions. If the authorities have the real interest of the citizens at heart, they will stop worrying over a system that must always prove faulty and unable to meet ever-growing and yet unknown demands, and pay more attention to evolving a necessarily costly but at the same time thoroughly efficient plan for clearing out the bewildering assortment of wires, pipes, conduits, and sewers now under our main streets. They must, perforce, change their methods before long, for the limit of time and space is very nearly reached.

IF the time soon comes, as we believe it will, when the use of automatic brakes and couplers on freight trains will diminish to a trifling fraction of the present rate the loss of life and limb by railway employés, the result will be due in no slight degree to the unselfish labors of one man, ex-Railroad Commissioner L. S. COFFIN, of Fort Dodge, Iowa, in first informing himself on the subject and afterwards informing the public. Mr. COFFIN, in 1886, while still Railroad Commissioner, devoted several weeks of time to this end, and went through a severe and even dangerous ordeal, in attendance on both series of Burlington brake tests, riding throughout in the rear car, where the severe shocks came. This he did to satisfy himself that there really was an available remedy for the dangers of the present freight system. The result having been to conclusively prove that both automatic brakes and automatic couplers were feasible for freight use, Mr. COFFIN has since devoted much time and labor to creating a sentiment demanding these improvements, and not without effect. At least, the reform moves on, as details in regard to both of these great betterments, which we shall shortly publish, will strikingly show. His last effort lies before us in a circular addressed to the "Christian and Humane Editors of this Nation," an appeal which has been quite extensively heeded by the non-technical press. The progress being made in this direction is much greater than the general public imagine; and ten years from now, we fully believe, there will be very few freight cars run without both automatic brakes and automatic couplers. Possibly this will come about in still less time, for the world moves fast now-a-days, and the fearful aggregate of deaths and injuries from coupling cars appeals to the sympathies of every intelligent man. A little judicious legislation would hasten the day, and is much to be desired.

IT begins to look increasingly probable that New York will lose its chance for holding an 1892 fair altogether. Public interest and confidence is visibly decreasing, so much so that neither the Finance nor the Site and Building Committee were able to muster a quorum at meetings ordered this week. No zealous millionaires, on the committee or off of it, are coming forward with offers of subscriptions. An effort to get subscriptions among the many wealthy members of the General Committee was hastily checked after $200,000 or so had been subscribed, but not till it had become apparent that it was necessary to do so, because of the alarmingly rapid decrease in the size of the subscriptions offered.

How much of this is due to other causes, and how much to the unfortunate action of the Site and Building Committee in restricting their recommendations to an unattainable site and unoriginal buildings, it is impossible to say; but doubtless it is largely if not wholly due to the latter cause, and if so, it is

still not too late to reconsider the matter and give New York a chance. There is nothing in the committee's recommendations as they stand either to convince the judgment or kindle the imagination of the average citizen, and it is necessary to do both to have such great undertakings succeed. On the other hand, the suspicion is growing that the committee gave undue attention to those most zealous in pressing advice upon them, and that these were real-estate men interested in the singularly inert property around the north end of Central Park, which would of course get a great "boom" from having an exhibition within the park. In the meantime, Chicago, if reports are true, has $8,000,000 actually pledged, and 2 per cent. paid in, and no difficulty in getting quorums in response to committee calls has yet developed.

WHILÆ some form of the block system, as we explained last week, must eventually be adopted on all railways of heavy traffic, and while we believe that its introduction is proceeding very much slower than the proper safety of the traveling public and the best interest of the railways demand, yet it is of course true that the great bulk of the railways on this continent will continue to be operated under the train-order system for years to come. It will not be well, therefore, to relax any of the effort which is being made to perfect the standard code of train rules in use under the present system. The late Palatine Bridge accident on the New York Central, to which we have before alluded, should call attention to one of the weak points in the present standard code, regarding the method of protecting the rear of trains. The accident was primarily due to the slackening of speed of the forward train, which gave the rear brakeman insufficient time to flag the second section. It seems plain enough that there should be some efficient means of giving warning to a following train when a train close ahead is losing time for any reason. In the admirable, although now somewhat antiquated, book of Mr. MARSHALL M. KIRKMAN, on "Railway Service: Trains and Stations," the author, in a suggested standard code of train rules, has the following:

> A fusee must be used as an extra caution signals. It must be lighted and thrown on the track at frequent intervals, by the flagman of passenger trains at night or in foggy weather whenever the train is not making schedule time.
>
> A train finding a fusee burning upon the track must come to a stop and not proceed until it is burned out.

THE standard code, now in use, describes the fusee as "an extra danger signal, to be lighted and placed on the track at night in case of accident or emergency," and a train finding one burning must stop, and not proceed until it is burned out. But there is nothing further, stating when and by whom the fusee is to be used, and we question whether it is used at all for the purpose for which it is so admirably adapted, to give warning to a following train that the train ahead is running at reduced speed. Even in the daytime, on the closely crowded tracks of some of our railways, some means of doing this is urgently needed. It is of course true that a road which is doing business enough to run passenger trains with an interval of only 10 or 15 minutes ought to adopt some form of blocking; but while the block system is being put in, a few fusees where the rear brakeman can get at them, with an order instructing him how and when to use them, may serve as a great safeguard in an emergency. There is perhaps some danger that lazy brakemen would rely too much on fusees, and would not show the same diligence in hastening back with the flag as soon as the train stopped. But it seems possible to avoid this danger by proper rules.

Formulæ for Safe Loads of Piles.

We review at some length in another column Prof. IRA O. BAKER'S new "Treatise on Masonry Construction." Of the book in general we have been gratified to be able to speak in the highest terms. Of what is given on the subject matter of this article we were unable to speak so highly, and as the subject is a broad one, and one which it is quite desirable should be reduced to some basis of general agreement, and as Prof. BAKER gives some new data on the subject, it seemed much better that we should make the subject one for general discussion than to attempt to cover it in a review.

In our issue of Dec. 29, 1888, we discussed this same question at some length, using as a text a letter from Mr. JOHN C. TRAUTWINE, Jr., and an admirable paper by Mr. RUDOLPH HERING, giving a comparative abstract of some fifteen different formulæ. The conclusion we reached was expressed as follows:

> It appears to us, therefore, and we suggest to the profession as the result of no little examination of the facts as to pile-driving at various times, that there is no better or safer formulæ than the following for *the safe working load for piles under all ordinary conditions, to be reduced under exceptional conditions* (as notably with irregular penetration) *but never exceeded* unless the pile is known to rest on rock and act as a column, viz.:
>
> $$L = \frac{2\,w\,h}{s+1}$$
>
> in which L = safe working load in pounds, tons or other unit; w = weight of hammer in the same unit; h = fall of hammer in feet, and s = last penetration in inches, assumed to be sensible and at an approximately uniform rate (and head of pile in good condition, as elsewhere expressed.) The formula is at least consistent and cannot lead astray, as the miscellaneous assortment in our large table is very liable to do.

To the "miscellaneous assortment" here alluded to, Prof. BAKER has now added another; and we propose to show (1) why we distrust his formula also for practical use, and (2) why his additional data confirms our belief that the above simple formula is really the best and safest, as well as the simplest, of any now before the profession. That the reader may have before him the grounds on which we originally based this conclusion, we reprint in another column some liberal extracts from our former article.

Prof. BAKER'S "formula for practice" is in reality the following interesting equation, to duly express which we shall have to take two columns:

$$P = \sqrt{W\,h\,\frac{12\,S\,E\,s\,e}{3\,L\,s\,e + 4\,l\,S\,E} + \frac{36\,d^2\,S^2\,E^2\,s^2\,e^2}{(3\,L\,s\,e + 4\,l\,S\,E)^2}} - \frac{6\,d\,S\,E\,s\,e}{3\,L\,s\,e + 4\,l\,S\,E}$$

The author eliminates a handful or so of these variables, it is true, including length (L) and section (S) of hammer, length (l) and section (s) of pile, and elastic modulus of hammer (E) and pile (e), by letting

$$q = \frac{6\,S\,E\,s\,e}{3\,L\,s\,e + 4\,l\,S\,E}$$

when the above long equation reduces to

$$P = \sqrt{2\,q\,W\,h + q^2\,d^2} - q\,d.$$

By assigning certain assumed average values to the several variables in q, he further obtains a numerical constant of 5,000 for q, giving the equation the form:

$$P = 100\,(\sqrt{W\,h + 50\,d)^2} - 50\,d.)$$

in which P = the ultimate load in tons which will move the pile, W = weight of hammer in tons, h = fall of hammer in feet, and d = last penetration in feet.

This form, the author tells us in italics, "*is the form to be used in practice*" (p. 239); yet immediately thereafter (p. 245) he tells us that "if it is thought not desirable to trust entirely to theory, then the above equations may be considered as giving only the form, and q be determined by experiment." Four pages later he tells us that "the factor of safety ranges from 2 to 12, according to the importance of the structure and to the faith in the formula employed," which leaves a range of 600 per cent. for the inner consciousness to work in, and makes any great elaboration in the formula ridiculous, while on the very next page we have the amazing declaration (italics ours): *In a few cases a small settlement has taken place* in a railroad trestle *when the factor of safety was* 3 *or* 4, as computed by equation (4), page 239."

We must confess our inability to comprehend that state of mind among scientific writers which so frequently enables them, as in this case, to say on one page that a proper safety factor for a given formula ranges "from 2 to 12," and on the very next page that failure has been known to occur under a factor of 3 to 4. Where does the element of scientific precision or caution come in, if it be admissible to put forward a formula as giving a proper assumption for ultimate load which in a few cases (out of the very few which it is possible to examine) proves three or four times too large? It may be claimed, however, as is done in behalf of separate wheel loads for computing bridge strains, that such a formula, while it has no absolute precision, is at least correct in form, and hence leads to an evener distribution of strength and material under varying conditions. We propose to show, therefore, that, even from this point of view, the more elaborate formula is also the less correct.

For this purpose we may also use as primary basis for comparison a paper which is one of the many new references in Prof. BAKER'S most valuable work, and which has heretofore escaped our attention, viz., a paper by Mr. A. C. HERTIZ, giving actual records of the driving and subsequent pulling up of nearly 400 piles,* and hence having a more solid experimental basis than most other papers on piles. Mr. HERTIZ found the following relation:

$$d = \frac{W\,h}{P} - \frac{P}{500},$$

which Prof. BAKER transforms into the equation

$$P = \sqrt{500\,W\,h + (250\,d)^2} - 250\,d,$$

justly remarking that it has precisely the *form* of his own equation for practice, though deduced in an entirely different way. Let us see precisely how much this identity of form means, however, by working out a few numerical examples to cover the range of ordinary practice.

The extreme range in last penetrations may be said to be from 0½ to 5 ins., or say 0.05 to 0.4 ft. The extreme fall ever used may be said to be 30 ft. for last blows, and the extreme weight of hammer 1½ tons or thereabouts. Regarding $W\,h$ as a compound unit, as we can do by any of the formulæ, values of 10, 20, 30 and 40 ft. tons will cover all necessary range, and tabulating on this basis we get the following rather striking comparison between the Baker formula, Hertiz formula, and our own simple rule of *Safe Load* $= \frac{W\,h}{s+1}$.

It needs but the most cursory comparison of these three tables to see at once that in the two great tests of reasonable absolute values

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* Bearing Piles, Formulæ for the Sustaining Power, Size, and Distribution in any Foundation. By RUDOLPH HERING, C. E. 2d Ed. ENGINEERING NEWS Popular Library. 25 cts.

*Proc. Inst. C. E., lxiv, 311-15, republished in Van Nostrand's Magazine, xxv. 373-6.

ULTIMATE RESISTANCE (VALUE OF P) BY BAKER'S FORMULA.

Wh. ft. tons of blow.	Last penetration in feet, d = 0.5	0.1	0.2	0.3	0.4
	Ultimate Resistance of Pile.				
10	153.1	91.6	48.8	33.0	24.8
20	262.3	170.8	95.4	65.3	49.5
30	352.1	241.6	140.2	96.9	73.6
40	430.1	306.2	183.2	127.9	97.6

ULTIMATE RESISTANCE AS DEDUCED BY HERTIZ FROM RECORDS OF 400 PILES.

10	59.3	50.0	36.6	28.1	22.5
20	88.3	78.1	61.8	50.0	41.4
30	110.6	100.0	82.3	68.6	58.1
40	129.5	118.6	100.0	85.1	73.2

SAFE LOAD BY ENG. NEWS FORMULA $L = \frac{2wh}{s+1}$

10	12.5	90.9	5.88	4.35	3.45
20	25.	18.18	11.76	8.70	6.90
30	37.5	27.27	17.65	13.04	10.34
40	50.	36.36	23.53	17.39	13.79

and of the relation of the different values to each other, the two formulæ for ultimate load, which have "exactly the same form," are much less symmetrical with each other than is the simple safe-load formula which we have proposed with either of them. In the first place, the Baker formula gives much greater safe loads than the Hertiz, as shown in detail as follows:

RATIO OF EXCESS OF ULTIMATE LOADS BY THE BAKER FORMULA OVER THOSE BY THE HERTIZ.

wh.	*Last penetration in feet.* .05	.1	.2	.3	.4
10	2.57	1.83	1.33	1.17	1.11
20	2.97	2.18	1.54	1.31	1.20
30	3.17	2.42	1.70	1.51	1.27
40	3.33	2.58	1.83	1.50	1.33

	Ratios	
Taking the four corners of this table, illustrating extremes, they stand.....	2.57	1.10
	3.33	1.33
Comparing in like manner the four corners of the last two tables, showing the excess of the Hertiz ultimates over our own *safe* loads, they will stand.....	4.75	6.50
	2.59	5.30
Comparing our own safe loads with the Baker ultimates, similarly, they will stand	12.2	7.2
	8.6	7.1

It will be at once seen by the careful reader that the simplest formula "splits the difference" between these two more elaborate forms, so as to come closer to either of them in its ratios than they do to each other. We agree with Mr. BAKER in his evident feeling that the Hertiz formula is not entitled to full credence as to absolute values. Nevertheless, it is notable that under all conditions his own, of "exactly the same form," gives from 10 to 233 per cent. *larger* ultimate loads, never giving less. We shall show shortly that this results from an actual defect of form, and it tends somewhat to explain why certain piles have failed under one-third to one-fourth of his ultimates. It should be added in fairness, however, that these ultimates correspond very well with those of the hatful of other formulæ [reviewed in our issue of Dec. 29, 1888, showing about a mean between them at what we may call the unit value, that for 30 ft. fall of 2,000-lb. hammer with 0.1 penetration.

Now, in the first place, is it in fact warranted by good practice to load piles with larger loads than are given by the $\frac{wh}{s+1}$ formula as tabulated above? We do not think so. Calling the weight of masonry 2 tons per cu. yd., the above table permits of loading piles, 3 ft. between centers, with 50 to 75 vertical feet of solid masonry, and piles 2½ ft. between centers with 75 to 110 ft. of masonry. More, we believe, is never warranted, and never imposed by careful engineers. The proper alternative is to step out the foundation to give more area until enough is secured. Prof. BAKER, on page 248, quotes examples (which he might well extend) showing 13½ to 20 tons per pile, but although the piles under the exceptional Royal Border bridge carry 70 tons, yet as Mr. TRAUTWINE would say, "it is a wretched precedent for bridge building." On the other hand, he quotes an example of some piles driven in a work under the supervision of one of the editors of this journal,* which lead to a quite opposite conclusion, as follows:

The South St. bridge approach, Philadelphia, fell by sinking of the foundation piles under a load of 24 tons each. They were driven to an absolute stoppage by a 1-ton hammer falling 32 ft. They were driven through mud, then tough clay, and into hard gravel. . . . It is more probable that the last blow was struck on a broomed head, which would greatly reduce the penetration, and that consequently their supporting power was overestimated. According to TRAUTWINE'S formula,—the only one of all the preceding which is even approximately applicable to this case,—their supporting power was 164 tons.

The author is in error in supposing the piles were broomed. That was carefully avoided. As an instructive instance, which now is almost forgotten, of the dangers besetting the pile-driver, we reproduce in another column from the Trans. Am. Soc. C. E a cut showing the conditions, with an explanation of the facts. No formula could be properly applicable to this case, but the author errs in saying that TRAUTWINE'S formula is the only one he gives which is "even approximately applicable." His own is perfectly applicable, with the sole exception that it gives an absurd result. Since $d = 0$ it reduces to

$$P = 100\sqrt{Wh}$$

whence we find the sustaining power of these piles ought to have been 565.7 tons! A formula which becomes absurd under extreme conditions is *ipso facto* shown to be defective in form. Nor is it necessary to make the conditions very extreme to know this. Had d been ¼ or ½ or ¾ in, we should have obtained the almost equally absurd results of 474.5, 400.0 and 340.3 tons respectively. Under the same conditions the simple $\frac{2wh}{s+1}$ formula would give

For $s = 0$ $S = ¼$ in, $S = ½$ in, $S = ¾$ in.
Safe load = 61.0 tons. 56.2 tons. 42.7 tons. 36.5 tons.

These are just about such loads as ordinary practice would warrant, and this brings us to what is our principal objection to the more elaborate formulæ given, which is that they are even theoretically defective, in giving far too great proportional loads for the smaller penetrations, for a reason well expressed by the author himself: "No formula can be accurate which does not, in some way, take cognizance of the condition of the head of the pile." The $s+1$ factor does this; the more elaborate formulæ do not do it; the Trautwine $\sqrt[5]{h}$ formula does far too much of it.

We therefore feel that we are even better justified than before in recommending to the profession the simple formula

$$Safe\ load = \frac{2wh}{s+1}$$

[in which w = weight of hammer in same unit as safe load, h = fall in feet and s = last penetration in inches] as not only the simplest but the safest and best for practice. In so very uncertain a matter it is wrong in principle to start for high ultimates which are *certainly unsafe* as a unit, and allow foolish men to deceive themselves with the notion that they are being cautious when they divide it by three or four, when they are really running great risks. The carnal mind longs for this comforting assurance, but the true formula for pile-driving is one which is *certainly safe* in any kind of uniform material, leaving the engineer to realize that he is running risks (which yet maybe justified and reduced by caution), if in special cases he goes beyond it. The engineer who goes beyond $\frac{2wh}{s+1}$ in our opinion takes a risk.

*See Trans. Am. Soc. C. E., vol. vii. (1878) p. 264.

Traffic Associations before the Interstate Commerce Commission.

Probably very few of even the best informed railway men realize the difficult and delicate nature of the task which the Interstate Commerce Commission is expected to perform. The law which they are required to interpret and execute was passed in obedience to an overwhelming public sentiment in favor of some regulation of interstate commerce by the general Government; just what that regulation should be was left in many respects within the discretion of the Commission.

The public is united in its hostility to the railways, and it has a keen appreciation of the evils of railway maladministration in general. As regards the especial sources of evil, however, and their proper remedies, it is thoroughly ignorant; and its criticism of the acts of the Interstate Commission is based on its "little knowledge," which in this case is most certainly a dangerous thing. Now it is in the highest degree essential that the Interstate Commission should so enforce the law as to satisfy public opinion. It will not do, therefore, to go too far in advance of the education of public opinion; and any action which might give color to a suspicion that the Commission was unduly favorable to the railroads must be taken only under urgent necessity.

The questions which the Commission must decide, therefore, are not only as to what is equitable and just and in accordance with the law, but as to what is, on the whole, expedient, in view of the unenlightened state of public opinion.

It is by remembering these facts that we are able to appreciate the tact and good judgment which the Commission has thus far shown in dealing with the delicate question of railway combinations. The omnipotent public read the Interstate Commerce Law as it passed Congress, and supposed that the combination of railway corporations to fix freight and passenger rates was absolutely prohibited. Whether this was actually the intention of the framers of the law is uncertain; but it is certain that, taking the law as it stands, the only form of combination prohibited is "pooling," or the division of earnings of separate and competing companies.

At the time when the Interstate Law took effect, therefore, the railway companies simply changed the form of their combinations to traffic associations, abolished the division of earnings, and continued to fix traffic rates and prevent rate-cutting as well as they could under the changed conditions. There was considerable surprise at this on the part of those who had supposed that all these combinations were prohibited; and it seemed likely that a good deal of dissatisfaction with the Commission, and with the law would arise. But the serious rate wars of 1888 satisfied the public that the Interstate law was getting "in its work on the railways after all," and that the anti-pooling clause had at least broken the strength of railway combinations.

The evidence that this is the real attitude of the public toward railway combinations is not wanting. The testimony of shippers and commercial organizations before the Senate Committee on Canadian Competition last spring brought out much of this sentiment. Especially notable was the utterance of the Chicago Board of Trade, condemning railway traffic associations of every sort, and calling for their suppression. The resolutions offered in Congress, at the time when the preliminary steps were taken toward the formation of the

Interstate Association, are another example of the same feeling.

Now it is all very true to say that public opinion on this matter is unintelligent and unwise, and that traffic associations, under the present conditions, are an absolute necessity to avert general bankruptcy. The fact remains that this public opinion must be respected and not too violently opposed. To so alienate public approval from the Interstate Law and its present administration as to cause its repeal, would be a long step backward and would do untold injury to both the railways and the public.

The most recent case in which Chairman COOLEY has had to exercise his admirable tact in this matter, is in the case of the Interstate Railway Association vs. the Chicago & Alton Railway. In the original proceedings, counsel for the defendant moved to dismiss the complaint on the ground that the Association was neither a corporation nor a person, and could, therefore, have no standing. Judge COOLEY refused to decide upon this question, and suggested that the names of the complainant companies be substituted for that of the Association, which was done. Chairman WALKER, of the Association, expressed surprise that any question of the standing of the Association should be raised, and indicated a wish to push the matter to a conclusion and obtain some decision from the Commission at a future time. It is to be hoped, however, that his usual good sense will be evidenced here, and that he will refrain from pressing the matter. There is really nothing to be gained by it, for any complaint can be as well made by one of the members of the Association.

On the other hand, there is every reason why the Interstate Commission should not run counter to public sentiment, as it would assuredly do if it should officially recognize the Interstate Railway Association, especially when no important point is at issue.

It has been suggested that the Interstate Association be incorporated; but the evil results of such an action would soon be manifest. In the first place, no legal charter could be granted under the common law, since it is an association formed for the direct purpose of restraining competition. Furthermore, the public, or at least the legislators, must be educated to some understanding of the vital fact that traffic associations are a necessity to prevent the weaker companies from being swallowed by the stronger, thus wiping out all possibility of competition; and until this truth is comprehended by the public, it is not best to push the traffic association into public notice.

The danger which must be faced is that the orce of public opinion will be strong enough to pass laws limiting still further the power of the railways to combine for the purpose of fixing rates. In Missouri, indeed, a law has already taken effect prohibiting combinations in restraint of competition of every sort.

Chairman WALKER and those at the head of other traffic associations will do the best service to their clients and to the public as well if they refrain from bringing their work into too great publicity, and if they discountenance any attempt to raise rates to a point that will give the public any just cause for complaint.

PERSONAL.

Mr. THOMAS S. ACHESON, Manager of the Ball Electric Lighting Co., New York, died last week.

MR. J. R. DRAPER has been appointed Engineer of Bridges on the Baltimore & Ohio system.

Mr. W. H. BAKER, Superintendent of the Syracuse Forging & Gun Works, at Batavia, N. Y., died Oct. 10. He was the inventer of the new Baker gun.

Mr. THOMAS BUTTERWORTH has been appointed Master Mechanic of the Detroit, Lansing & Northern, with headquarters at Muskegon, Mich.

Mr. T. B. SANFORD has been elected President of the Troy & Boston Railroad Company, in place of the late Mr. DANIEL ROBINSON.

Mr. C. R. BARNHART has been appointed Superintendent of the Indiana Midland Railway, with headquarters at Andersen, Ind.

Mr. JOHN W. THOMAS, Jr., has been appointed Assistant General Manager of the Nashville, Chattanooga & St. Louis.

Mr. V. H. STEVENS, Train Dispatcher of the Chicago, Santa Fé & California, has resigned to become General Superintendent of the Atlantic & Danville.

Mr. J. D. MILLER, patentee of the "Duplicate," or American cable system, now in use on the Tenth Avenue line in this city, died at Chicago, Sept. 27.

MOFFETT, HODGKINS & CLARKE, Water-Works Engineers, contractors and owners, have moved from Watertown to Syracuse, N. Y.

Mr. W. J. HAYLOW, Trainmaster of the Louisville & Nashville at Montgomery, is to become Assistant to the General Manager of the Alabama Midland.

Mr. W. S. CHADWICK has been elected President of the Atlantic & North Carolina Railroad, to succeed Mr. WASHINGTON BRYAN.

Mr. A. C. RIDGEWAY has been appointed Assistant Superintendent of the second and third divisions of the Denver & Rio Grande, with headquarters at Salida, Col.

Master Mechanic TWOMBLEY, of the Rock Island road, recently sent in his resignation, pending further investigation of the recent suburban train wreck. G. F. WILSON has been appointed Acting Master Mechanic.

Mr. JOHN C. GOODRIDGE, Jr., was elected by the Board of Proprietors of East New Jersey, on Oct. 16, Surveyor General, to succeed Prof. GEORGE H. COOK, deceased.

Mr. GEO. S. RICE, Deputy Chief Engineer of the New Croton Aqueduct, was married Oct. 10 to Mrs. R. B. PORTER, daughter of Mr. ALPHONSE FTELEY, Chief Engineer of the Aqueduct.

Mr. C. H. HUBBELL has been appointed Superintendent of the Southwestern Division of the Rock Island lines west of the Missouri River, with headquarters at Goodland, Kan.

Mr. W. C. LOREE is to succeed Mr. A. ZAAK as Engineer of Maintenance of Way of the second and fourth divisions of the Pennsylvania lines west of Pittsburg.

Mr. E. L. TYLER, who received an offer from the Central of Georgia, which he accepted, has asked to be released, and will retain his position as Superintendent of the New Orleans & Northeastern division of the Queen & Crescent route.

Mr. JOHN A. BENSELL, for many years Assistant Supervisor of the Pennsylvania Railroad, at Jersey City, has resigned to accept a position in the Dock Department of New York.

Mr. J. F. WHITE has been appointed Master Mechanic of the Fort Worth & Denver City road, succeeding Mr. E. P. HENDERSON, who has been appointed to the position of Master Mechanic of the Denver, Texas & Fort Worth, a place made vacant by the recent retirement of Mr. FRANK W. MORSE to enter the service of the Wabash.

Mr. R. C. HARRIS has accepted the position of Superintendent of the Lake Shore's Kalamazoo division to succeed Mr. TRACY W. NILES, who has been transferred to the office of Assistant Superintendent of the Franklin division.

Mr. W. G. BROWNSON, late Superintendent of Ferries of the Jersey Central, has been appointed General Manager of the Eatawville Railroad, with headquarters at Sumter, Fla. He is succeeded on the Jersey Central by Mr. F. F. GREGORY.

Mr. JAMES MONTGOMERY, Superintendent of the Ohio Valley Railway, has resigned, and Mr. W. HEGEMANN, who has been connected for many years with the Baldwin Locomotive Works, has accepted the offer to fill the vacancy.

Mr. DAVID S. GARDENIER, of Hudson, N. Y., for some years Trackmaster on the Hudson River Railroad, has been appointed Roadmaster of this division, which extends from Poughkeepsie to Troy, with headquarters at Hudson.

Mr. K. H. WADE has been appointed General Manager of the California lines of the Santa Fé system. Mr. WADE was General Superintendent of the Wabash system under Gen. McNulta's receivership.

Master Mechanic H. D. GORDON, of the Philadelphia, Wilmington & Baltimore, has resigned. He is succeeded by Mr. C. G. TURNER, general foreman of the Wilmington shops. Mr. GORDON is to take charge of the Juniata shops of the Pennsylvania at Altoona.

Sir DANIEL GOOCH, the well-known engineer, is dead at the age of 74. He began professional work under ROBERT STEPHENSON. He was chief engineer of the mechanical department of the Great Western Railway for 27 years, and was one of those chiefly concerned in building the *Great Eastern* steamship.

Col. S. H. LOCKETT, of New York, has just completed a survey from Carthagena, U. S., of Colombia, through Calamar, Campo de la Cruz, Candleria, etc., to San Estanislao. The survey is for a railway to be built by American capital, says the *Promoter*, of Barranquilla.

Mr. CHARLES M. SCHAWB, a young man of 27 years, has been appointed General Superintendent of the Edgar Thomson Steel Works of Carnegie, Phipps & Co., to succeed the late Capt. W. R. JONES, who was burned to death two weeks ago by an explosion. Capt. JONES was paid $25,000 a year. His successor, who will have charge of the 8,000 men employed at the Edgar Thomson and Homestead Steel Works, has been with the firm for 8 years past and was Capt. JONES's chief assistant. He is a graduate of St. Aloysius Academy, Loretta, Pa.

Capt. THOS. W. SYMONDS, U. S. Eng'r., who is now Engineer Commissioner of Washington, D. C., was for a long time the assistant in the same office, and he is credited by the Washington *Star* with inaugurating some most important reforms in the methods of street improvements in that city. Among these are mentioned the retention of cobble and rubble stone pavements as a base for asphalt pavements substituted, which means a saving of 75 cts. per yard; the substitution of macadam for gravel in streets to be partially improved, a saving of about 50 cts. per yard; and devising new types of artificial stone sidewalks. Capt. SYMONDS was also prominent in planning and advocating the Grant Memorial Bridge to Arlington and the Rock Creek National Park.

Hon. D. C. LINSLEY, C. E., died in New York Oct. 7, at the age of 72. He was a native of Vermont, and began his business career about 1847, when he was only 20 years of age, on the Rutland & Burlington Railway, on the survey of which he was engaged for three years. After this road was in operation he went to Illinois in 1851, and supervised part of the construction of the Illinois Central. In the year 1855, the contract being finished, he returned to Vermont. While engaged in newspaper work he received an appointment as Superintendent of the Government building at Windsor, then in the early process of construction.

In 1859 he made a contract with the Central Vermont Railroad Co. to construct the branch of that road now existing between Burlington and Winooski. It was during the process of this construction that the tunnel north of the lumber yards was built by Mr. LINSLEY, and it was then regarded as a wonderful piece of work, being the first one that was ever built through sand. During this time, and that immediately following, he built the Central Vermont Depot at Burlington and one at St. Albans. He also superintended the building of the Montreal & Vermont Junction and Lebanon Springs roads.

In 1870 he was elected Mayor of Burlington, being a Democrat. He served in this capacity until 1871, when he retired from that office and went to Minnesota and constructed a portion of the Northern Pacific in that State and Dakota, having his headquarters at Brainerd, Minn. After remaining in the West for three years he returned East, and constructed the Canada Atlantic road from Ottawa to Capolle. Some years after the completion of these roads he came to New York, where he was the projector of the rapid transit road between Boston and this city.

For the last two years Mr. LINSLEY has been a resident of New York, and at the time of his death he was engaged on the plans for an elevated railway enterprise here.

BOOK REVIEWS.

A Treatise on Masonry Construction, by IRA O. BAKER, C. E., Professor of Civil Engineering, University of Illinois. New York. JOHN WILEY & SONS. 8vo. pp. 552, 160 cuts, 6 folding plates, 65 tables. $5.00.

We have become accustomed to turn with considerable confidence to the last page of technical volumes, when it becomes necessary to review them, to judge by the quality of the index of the general quality of the volume. In some cases the rule does not work, must be admitted. Works with an execrable index, or even (as too often happens with some prolific technical writers) no index at all, nevertheless prove to be full of profitable matter. But we recall no instance in which the contrary has proved to be the case, i. e., that a book with a good index has proved to be in itself poor; and this work is no exception to the rule. The index is good, the book itself is good, and both alike bear evidence of conscientious care and good judgment in preparation.

In fact, we should be doing injustice to both author and publisher did we not declare at once our conviction that this is the most valuable and complete treatise on masonry as yet published, at least in English. Of other languages we cannot speak so positively, but judging by our general knowledge of their literature we should risk little by including them also. The distinguishing merit of the work is that it is fresh and up to date, a rather rare quality in technical books, which are apt to be some years behind the times. So far as our examination has gone, the author is justified in the claim which he advances that "nearly all the matter is believed to be entirely new," if by "new" is meant, never before published in book form. Of absolutely new matter, which has never before been published in any form, there is much less; but the care taken to glean from the columns of this and other technical journals and from the papers of engineering societies all that was newest and most valuable in regard to masonry, has evidently been very great, and has borne fruit in a most admirable volume.

Not that there are not certain faults to find with it. That reviewer must be a poor one who cannot find some faults to complain of, and in this case there are some real ones to note; although the most serious ones are sins of omission rather than commission; and even without confining our comment to those confessedly prepared as college text-books primarily, as this one is (such books being very apt to be rather thin and elementary for practical use), we have rarely seen a book of the kind more full of meat and nothing but meat. We are gratified to observe that among the periodical publications which the author has drawn on in his search for the newest material, the columns of this journal have proved decidedly the most useful of all, but he has plainly looked for and "taken his own wherever he found it," and with more than usual honesty given full credit in every case which we can discover where he has drawn on this or any publication for his facts or theories.

The author modestly declares in his preface that "the matter is essentially that presented to his classes for a number of years past, a considerable part having been used in the form of blue-print manuscript text-books. It is now published for the greater convenience of his own students, and with the hope that it may be useful to others." The hope is not unreasonable, and the students are to be congratulated who have as good and fresh lectures on all subjects as this book gives evidence of on the subject of masonry, if indeed there are any such.

The work is divided into four parts, viz., Materials (79 p.) Preparing and Using Materials (104 p.) Foundations (128 p.) and Masonry Structures (218 p.); with an appendix of 14 pages, chiefly on specifications,—a very fair division of space. The three chapters on Materials wisely avoid the wide excursions into the fields of geology and mineralogy which are apt to precede treatises on masonry and engineering, and deals instead with the records and modes of making tests, absorptive power, effect of frost, etc., making the first use of some valuable material in the 1880 Census on this subject, but missing some still more valuable material (now existing only in pamphlet form) collected for the foundations of the Albany State Capitol. Frequent references to fresh matter appear, but we miss any such to some valuable papers on brickmaking in Trans. Am. Soc. C. E., 1888.

The chapter on Lime and Cement strikes us as an exceedingly judicious abstract of the large amount of fresh matter on this subject which has been appearing in late years in the Trans. Am. Soc. C. E., in this journal and elsewhere. The English, French, and Austrian tests for Portland cement are also given. It is quite too much of an undertaking for us to go through all this material in detail to see if all of it has been included which should be included. Opinions would differ in any case; but we detect no evidence that the author has not exercised his judgment on this point, and not simply neglected the fresh matter.

The same remarks apply in substance to the related chapters on Mortar, Concrete, and Artificial Stone. Mr. E. C. CLARKE's name is abused by being misspelled on pp. 88, 89, while correctly spelled a few pages later, but the valuable contributions which he has made to our knowledge of this subject are there in full abstract. So also is an excellent table of Mr. KUICHLING on adhesive strength of mortars, extracted from an ephemeral report. The chapter is packed full of facts from such late sources of information. Artificial stones are properly treated very concisely. We do not find "granolithic" mentioned, an artificial paving-stone of real merit, but perhaps hardly masonry. It is certainly a form of concrete, however, and a very meritorious one.

The chapter on Quarrying, being only 9 pages long, of course leaves much to be said, but the matter, what there is of it, is good. The chapters on Stone Cutting and Stone Masonry for the first time put in book form some careful illustrated reports of Am. Soc. C. E. committees, endeavoring to define and standardize practice as to tools, dressing of stones, and forms of masonry. There is also some other good and new material in them. Pretty full details for estimates of cost are given, but for stone cutting they might well be fuller. For instance, there might well be more definite data as to the great difference in cost of dressing hard and soft stones, and dressing to inch, ½in., ¼in., and ⅛in., joints. The 21 pages on brick masonry seem to us an unexceptionally good compendium.

"Foundations" is of course a large subject and 128 pages a rather small space in which to deal with it exhaustively. The man who will prepare a book of 600 to 800 pages dealing practically and exhaustively with that subject alone, and especially in relation to the smaller and more frequent structures, giving full details of actual practice and results, will confer a public benefit, and reap great credit to himself. The present work is of course not thus complete on this head, but with some exceptions which we shall note, what there is on the subject is very good. The 20 pages of general discussion of natural foundations on rock or earth is well put together, but too general to be of much real use. The ideal instruction on this point is a collection of specific examples where partial or complete failure has resulted, but the material is hard to collect.

In the chapter on Pile-Driving we should be inclined to say that piles were practically always instead of "often" hooped, that the "expense of removing them" (hoops) was practically *nil*, that piles are not "generally sharpened," and that protection of the point by an iron shoe or V-shaped strap is a delusion and a snare, the shoes promptly stripping from the pile on its first contact with really hard material, and leaving the sharpened point to batter up worse than if it had been left in its natural state. We have never known it done, but we believe a ring about the lower point would be a more effectual protection than any other. Three pages on the water jet are much to the point, but hardly do justice to the extent to which the jet has been used in sinking iron piles of all sizes. The impression conveyed is that the Coney Island piles were among the first of their kind, which is by no means the case. As a whole we like the practical matter on piles very much, but we cannot say quite so much for the matter on "rational formulæ" for the supporting power of piles, which seems to us rather irrational, and which we discuss editorially.

We pass over the remainder of the matter relating to foundations with the simple remark that it is good and fresh, and free from the too common error of devoting most of the space to elaborate details of a few great examples, which is just what the engineer does not want in such a book, since if he ever gets a chance to put in one of these great foundations he must make a separate and exhaustive study of them, and knows already all that a book can say in a few pages. An exception, however, is the flared pneumatic cylinder shown on page 283. This is liable to betray into bad practice. Experience at the Hawksbury Bridge showed that while this flared form might possibly be all right for sinking through small depths, it was exceedingly troublesome for larger depths, making it almost impossible to sink the cylinder vertically. The author should by all means put in a caution on this point. The freezing process and other novelties will be found duly described.

The chapter on Masonry Dams is the only one among the recent books on this subject to which we should feel justified in referring the student as in no danger of leading into bad practice. The author indeed makes one rash statement, that "the assumption that water in hydrostatic condition finds its way under or into a *dam* is hardly admissible," but he corrects this by a footnote referring to FRANCIS' experiments showing that hydrostatic pressure is communicated almost undiminished through the interstices of 2 to 1 Portland cement mortar, and we trust that in future editions he will correct the above statement into one that, inasmuch as there can be no certainty that hydrostatic head will not exist apart from this capillary action, safety requires a factor of 2, assuming hydrostatic pressure to exist under the whole base of the dam, in all structures of such magnitude as to make their giving way a serious matter. At the top of page 320 the author quietly intimates his feeling that it is hardly expedient to make the Quaker Bridge Dam as bold a structure as has been proposed, in which we agree with him.

The question of "Straight Crest vs. Straight Toe," or in popular language of straight vs. curved dams, is most temperately and scientifically discussed, and we trust will go a long way toward settling theory and practice on this subject in accordance with the views expressed in the many discussions in this journal during the two years past, with which the author's conclusions are practically in complete accordance. The author lays down explicitly, with full statement of reasons, that "although it is not generally wise to make the stability of a dam depend entirely on its action as an arch, a gravity dam should be built in the form of an arch, i. e., with both crest and toe curved, and thus secure some of the advantages of the arch type," and the statement of reasons, in part quoted from this journal and in part original, must, we think carry conviction to any unprejudiced mind competent to judge. It is greatly to be regretted that a combination of circumstances should have led to the advancement of such a large amount of theoretical error (for such we cannot but regard it, and so regarding it, call it) as has appeared in relation to this question from sources which will and ought to command respectful attention, but which are all the more likely to deceive. Fortunately, "great is truth, and it will prevail," and we shall look with confidence to see all future treatises on this subject, coming as they will from unprejudiced and uncommitted sources, take the view that this one does.

The chapter on Dams closes with an article on Rock Fill Dams, the first recognition of the type in any technical treatise. The author states that "recent practice on the Pacific coast has introduced this type," which in a sense is true; but as respects the *type*, which we believe is destined to wide use hereafter, it might not unfairly be said that it was "introduced" by this journal, which also subsequently discovered some isolated examples already built but not previously recorded. Had it not been for these early discussions (which are fully recognized and quoted from by the author) we greatly question whether there would be even now any recognition of this type of dams or of the existence of specimens, in technical literature.

The chapters on Retaining Walls, Abutments and Bridge Piers are good, but call for no special notice. We do not think it is true that the "usual" batter for bridge is 1-12, although it may be. It is hard to strike such averages. We prefer ½ in all cases for piers, though not for abutments.

As to formulæ for culvert openings, the author expresses some confidence in for Prof. TALBOT's formula;

$$\text{Area in sq. ft.} = C(\text{acres drained})^{\frac{3}{4}}$$

in which $C = \frac{1}{4}$ to 1, the largest value being for steep side slopes. We are pleased to recognize considerable matter in the chapter on culverts also which has originated with this journal. Iron, vitrified pipe, and timber box culverts are also well treated in the same connection, largely if not exclusively by selection from the latest periodical literature. This chapter is a particularly good and complete one; far in advance of what is to be found on the same subject in any other book.

The following chapter on Arches we like very much. The comparison of various formulæ on the subject is well made and concise, and the table of 61 actual arches on p. 502-3 the most complete we know of, especially in doing justice to the unknown engineer who built the greatest arch in the world, in 1380, viz., the great arch at Frezzo, Italy, 251 ft. span, 88 ft. rise, 133 ft. radius, and 4 ft. keystone, which would doubtless be standing now had it not been blown up in 1427, and was a masterpiece of constructive art which the world should not forget. A short chapter on centers closes the volume proper.

It is a real satisfaction to be able to speak so highly of a new work as we can do and have done of this one. While not perfect, it is in every sense a *model*. If the author will only keep at work on the same plan for the next few years, expanding this work on its present plan by additions of fresh practical material and by "filling in the chinks," it will make a work of quite unapproached value, as indeed within its field it is now. It bears the marks of good honest work in investigation and digest, and is concise without being sketchy and elementary. In these respects it is a pleasant contrast to some of the "professorial" books which come before us, which are too frequently painfully thin and carelessly compiled, seeming as if they had been written only for the students who alone are likely to buy them. This work is a thoroughly practical one and no engineer can afford to be without it.

THE RAILWAY RETURNS FOR ENGLAND, WALES, SCOTLAND AND IRELAND, for 1888, as shown in the annual blue book of the railway department of the Board of Trade, may be tabulated as follows:

Total mileage in operation	19,812 miles
Increase in year	254 "
Total authorized capital	£970,564,156
Paid-up capital	£864,605,963
Capital per mile	£43,645
Passengers carried in 1888	742,499,164
Receipts from passengers	£30,984,090
" " freight	£38,755,780
" " all sources	£72,894,665
Working expenses	£37,762,107
Net receipts	£35,132,558

In 1888 the proportions of revenue received from passengers was 52.64 per cent., and from goods, 43.09 per cent. In 1887 this proportion was 53.10 and 42.51 per cent. There was a gain in the last year of 2.75 per cent. in receipts from all sources over 1887, and also a gain of 1.88 per cent. in working expenditure. The net receipts increased 3.7 per cent. over the previous year.

THE DELAWARE & HUDSON R. R. is equipping its trains with the Westinghouse train signal apparatus as a substitute for the ordinary bell cord.

Tracklaying in 1889.

Two of our contemporaries, the *Railway Age* of Chicago and the *Railroad Gazette* of this city, have published statistics by States of the tracklaying during the first nine months of 1889, which are compared in the following table:

States.	Age.	Gazette.	Variation Gazette from Age.
Maine	29	21	− 8
New Hampshire	38.1	25.5	− 12.6
Vermont	0.	0	0
Massachusetts	7	0	− 7
Rhode Island	0	0	0
Connecticut	0	0	0
Total New England	67.1	46.5	− 27.6
New York	108	111	+ 3
New Jersey	53	52.5	− 0.5
Pennsylvania	151.8	105.7	− 46.1
Delaware	0	0	0
Maryland	17.	4.8	− 12.2
Total Middle States	329.8	274.0	− 55.8
Ohio	88	44	−44
Michigan	131	76.5	− 54.5
Indiana	100.5	102	+ 1.5
Illinois	63.8	58.5	− 5.3
Wisconsin	30.	40	+ 10.
Total. Cen. No'n States	413.3	321.0	− 92.3
Virginia	176.5	124	− 52.5
West Virginia	0	0	0
No. Carolina	147	210.5	+ 63.5
So. Carolina	12.5	31.7	+ 19.2
Georgia	238.2	205.7	− 32.5
Florida	113.3	85.4	− 27.9
Total So. Atl. States	687.5	657.3	− 30.2
Alabama	76.8	65.2	− 11.6
Mississippi	140.5	203.5	+ 63.0
Tennessee	170.3	151.8	− 18.5
Kentucky	137	141.5	+ 4.5
Louisiana	87.2	75	− 12.2
	611.8	637.0	+ 25.2
Missouri	69.9	86.8	+ 16.9
Arkansas	22	9	− 13
Indian Territory	113	107	− 6
Texas	179.2	167.5	− 11.7
Kansas	53.4	56.2	+ 2.8
Colorado	83.1	80.5	− 2.6
New Mexico	0	0	0
Total So'w'n States	520.6	507	− 13.6
Iowa	0	0	0
Minnesota	49	60	+ 11
Nebraska	113	65	− 48
Dakota	10	30.8	+ 20.8
Wyoming	10	0	− 10
Montana	85	76.9	− 8.1
Total No' W'n States	267	232.7	− 34.3
Washington	214	254.3	+ 40.3
Idaho	18.5	7.1	− 11.4
Oregon	22	7.1	− 14.9
California	89.7	97	+ 7.3
Nevada	0	0	0
Arizona	0	0	0
Utah	10	10	0
Total Pac. States	354.2	278.5	− 73.9
GRAND TOTAL	3,312.1	3,111.3	− 201.2

It will be seen that the totals for each State show a large variation in each direction. If we take the total of the maximum figures for each State, we have the tracklaying to Oct. 1 as 3,573 miles; while if we take the minimum figures for each State, it is only 2,850 miles, which illustrates pretty fairly the difficulty in making up any exact statistics on the matter at a season of the year when the work is in progress.

The *Gazette* publishes the list from which its statistics are compiled and the *Age* publishes a partial one. Both err somewhat by the inclusion of roads which are properly classed as lumber roads, or motor roads for passenger traffic only, and should, therefore, be excluded. The *Gazette* includes some mileage which was laid in 1888. On the whole, however, the statistics seem to have been made up by both journals with more than usual care.

The *Gazette* also states that 265 miles have been completed in Mexico and 374 miles in Canada.

The Official Opening of the New London Bridge.

On Thursday of last week another all-rail route between New York and Boston was made an accomplished fact, and a half hour of tedious ferryage saved to the traveling public, by the official opening of the new bridge of the New York, Providence & Boston Railroad over the Thames at New London. Special trains from New York and Boston conveyed to the bridge a number of railroad officials, civil engineers and parties interested in the work; and amid a display of bunting, the bursting of bombs, and the noise of steam whistles the bridge was formally handed over to the company by Mr. A. P. BOLLER, the engineer of the structure, an was then declared open to travel by the president of the railroad company, Mr. BABCOCK.

The speech-making proper was reserved for the short trip taken upon the steamer *Connecticut*, and after an excellent dinner and a generous supply of wine had been disposed of by the thousand hungry guests present. In these speeches the noticeable feature was the evident appreciation, on the part of the president and other officials of the company, of the services of the engineer who had so successfully and satisfactorily planned and completed this really important work, the longest double-track drawbridge in the world. As the president expressed it, all the money and all the brains of the officers and stockholders combined could not have produced a single member of this bridge unassisted by the engineer,—a fact very generally known, but not always so fully recognized as on this occasion by the prominent speakers present. Mr. A. P. BOLLER, who was so deservedly honored, made a short but fitting reply, and left the bridge itself to speak for its designer. And this it can well do; for, limited as he was by fixed approaches and topographical conditions, and by the more powerful requirements of strict utility of purpose and a reasonable economy in cost, Mr. BOLLER has here produced a structure that by its form and dimensions alone is dignified and handsome in appearance. There is absolutely no applied ornamentation; but by flowing lines and a happy adjustment of essential structural details to an artistic purpose, the bridge is made effective in appearance as well as eminently useful in forming a missing link in a line of rail communication between two great cities.

A telling little incident in the opening ceremony at the bridge was the farewell of the old transfer steamer *Groton* to the scene of its years of faithful service. As soon as the draw opened the *Groton* passed through and back again, to the air of "Auld Lang Syne" as rendered by a band on the draw-span. This feature of the day was due, we believe, to a happy inspiration of General Manager MILLER, and in no way could he more effectively have emphasized the full meaning of the change in methods accomplished at the crossing of the Thames by the company he represented.

The Pennsylvania, Poughkeepsie & Boston Railroad.

The last link in the important new railway route from the Pennsylvania coal fields to central New England is nearly completed. The probability that a railway running from these coal fields to Poughkeepsie, or some other point where unbroken connections could be made over a Hudson River Bridge with the New England railway systems, would get a large coal traffic, and pay a large dividend on the capital invested, was seen many years ago. In 1882 the Pennsylvania, Slatington & New England R. R. Co. was organized by the consolidation of the Pennsylvania & New England and the Delaware & Slatington railway companies. The line was projected to run from Harrisburg, Pa., to Poughkeepsie, N. Y., a distance of about 190 miles. In 1883 the portion from Slatington, Pa., to Pine Island, N. Y., crossing the Delaware River at Portland, was placed under construction, and during the year, sections of the road from Columbia, N. J., to Wind Gap, Pa., 13.2 miles and from Deckertown, to Papakating, N. J., 5.1 miles, were completed, and 35 miles of the road-bed was graded ready for the rails. In addition a large amount of work was done in building viaducts and bridges at various points, including a long wooden bridge across the Delaware River at Portland.

At this stage, after having expended nearly $1,000,000 in construction, the company became involved in financial difficulties; and after a great deal of litigation went into bankruptcy. The property was placed in the hands of W. O. MCCRACKEN, of New York, as receiver, June 9, 1885, and was sold under foreclosure sale, April 20, 1887. The property was purchased by a syndicate headed by WM. W. GIBBS, then President of the Poughkeepsie Bridge Co., who paid $50,000 in cash, and assumed all the unsatisfied liens and claims, amounting to about $200,000. The purchasers soon organized a company known as the Pennsylvania, Poughkeepsie & Boston R. R. Co. to complete the road on the original plan. The contract was let to Wm. Baird & Co., of Pittsburg, Pa., and construction was commenced in December, 1888.

The road is now practically completed from Slatington to Pine Island, N. Y., where connection is made with the New York, Lake Erie & Western R.R. Trackage rights have been secured over the line between Pine Island and Campbell Hall, N. Y. The road has very favorable grades and curves, the maximum grade being 42 ft. per mile, with an average of 18 ft. per mile going east and of 34 ft. per mile going west. The maximum curve is 3°. There yet remains to be built the division from Slatington to Harrisburg, Pa., and it is intended to place this under construction early in 1890. A glance at a map will show the exceptionally convenient route which the line offers for carrying coal from the Pennsylvania mining districts to the markets of New England. At Slatington, connection is made with the Lehigh Valley and the Philadelphia & Reading systems, penetrating the anthracite coal fields of Pennsylvania. In addition to the above, traffic contracts have been entered into with the Lehigh & Susquehanna R. R., by which a direct line is secured into Philadelphia, also with the New York, Susquehanna & Western and the New York, Lake Erie & Western railways. Some of these companies have agreed to deliver to this road all coal intended for the New England States.

On the east, connection is made at Campbell Hall with the Central, New England & Western R. R., running from Campbell Hall to Hartford, Conn., with a branch from Silvernails to Rhinebeck, N. Y., where connection is made with the New York Central & Hudson River Railroad. At Hartford direct connection is obtained with all the large New England cities by the Boston & Albany, the Boston & Maine, the New York & New England, the Connecticut River, and the Central Vermont railways. While the bulk of the business will doubtless be in the coal traffic, a large business will also be obtained from the slate mines of Pennsylvania and New Jersey and the transportation of farm produce and milk to New York and Philadelphia. The route passes through a productive farming country, which until now has lacked a direct outlet to the great cities. On the completion of the line to Harrisburg, direct connection will be secured with the various lines of the Pennsylvania systems, and a large amount of traffic, now going over more circuitous routes to the New England markets, will be obtained by the new road. The officers of the company are: JAMES HUSTED, President, D. J. MCNIECE, Secretary, J. C. STANTON, General Manager, C. H. STANTON, General Superintendent, and S. G. PRIMROSE, Chief Engineer.

Panama Canal Efforts.

[From a Liverpool Correspondent.]

The Panama Canal at the present time is receiving a more than usual amount of attention amongst the French people, and as the general feeling throughout the entire country seems to be in favor of its completion if possible, any scheme put forward for its economical accomplishment receives every consideration.

A scheme, which seems to be somewhat more feasible than its predecessors, has been projected by M. LAULANIE and favorably received by a syndicate of wealthy Parisians, which leads one to believe that if ever the Panama Canal is completed, it will be by means of the capital of a few wealthy individuals and not by those who built the Suez Canal, viz., "the poor people in France."

It is also generally believed that if the Panama Canal scheme is taken up again, an endeavor will be made to obtain a new concession from the Colombian Government, with a view to abolishing Article 15 of the existing concession, granted May 18, 1879, to Lieut. LUCIEN N. B. WYSE, in the name of the Civil International & Interoceanic Canal Co., of Paris, and under which right the Panama Canal Co., has been acting. The article referred to reads as follows:

As indemnity for the rights and privileges conceded to the Canal Company, the Government of the Republic will be entitled to a participation equal to 5 per cent of the gross income of all that will be collected by the enterprise in virtue of the established dues or which will be established according to Article 14 during the first 25 years after the opening of the canal to public service. From the twenty-sixth until the fiftieth exclusively it will have the claim to a participation of 6 per cent.; from the fifty-first to the seventy-fifth, to 7 per cent.; and from the seventy-sixth until the termination of the privilege, to 8 per cent.

It is agreed to that these previous deductions will be made, as it has been said, upon the gross proceeds of all

the receipts, without any deduction neither for costs, or for interests of shares and loans, or for debts at the charge of the enterprise.

The Government of the Republic will have the right to appoint a commissioner or agent who intervenes in the collection and examines this account. The distribution or payment of this participation due to the Government will be made per half year expired.

The proceeds will be distributed as follows: 4-5 will be for the Government of the Republic, and the remaining 1-5 will be for the Government of the State through whose territory the canal passes.

The Canal Company guarantees to the Colombian Government that its participation will in no case be inferior to an annual sum of 1,250,000 fr. ($250,000) which it collects already for its participation in the Panama Railroad. If during any year the previous deductions of 5, 6, 7 or 8 per cent. would not reach this sum, the minimum indemnity of 1,250,000 fr. will be deducted from the social funds of the company.

M. LAULANIE estimates the cost of the completion of the Panama Canal by his scheme at $50,000,000. He proposes to follow the location already adopted, but instead of damming the River Chagres previous to its intersection at 25 different points with the canal, would throw the dams across the valley of that river along the route of the canal, and so form on the Atlantic watershed a series of three lakes at 16, 24, and 32 metres elevation above mean tide of both oceans.

Elevation 8 metres would be attained by means of a lock with an 8-metre lift, and elevation 40 metres by means of a fifth lock of the same lift, situated from Aspinwall at the far end of the third lake. This upper elevation M. LAULANIE proposes to supply from the Bas Obispo and Rio Grande and also to descend therefrom down the Pacific slope to Panama by means of 4 locks of varying lifts. The first lake, of 27,000 acres area and elevation 16 metres, would commence at kilo. 24 and continue on to kilo. 37½. The second lake, of 10,000 acres area and elevation 24 metres, would extend from kilo. 37½ to kilo. 43¾. The third lake, of 6,250 acres area, from kilo. 43¾ to kilo. 46, and at an elevation of 32 metres.

Elevation 40 metres is in an excavation through the Culebra Divide, and continues from kilo. 46 to kilo. 57, where the first of the four locks which take the canal down the Pacific slope is located.

The only difficulties with this beautiful scheme probably will be to get the money, to construct the works for the money after it is got, and to maintain the works intact after they are constructed. Otherwise, it strikes us as better calculated than any heretofore advanced to insure the completion of the enterprise.

State Ownership of Railways in Holland.

The purchase of the Dutch-Rhenish Railway by the State is one of the most important events in the railway history of Holland. The undertaking is the second oldest in the country, and dates back from 1845. The chief lines run from Amsterdam and Rotterdam, via Utrecht, for the German frontier, and from Gouda, on the Rotterdam section, to the Hague, where a steam tramway connects the main system with the watering place of Scheveningen. There is also a short loop line from Rotterdam to Amsterdam. The whole of these lines, partly built with the money of English capitalists, who were represented on the Board, will be taken over by the State as from May 1, 1889. The company which works the State railways in Holland will enter upon the lines of the Dutch-Rhenish Railway as soon as its shareholders, who have been convoked in extraordinary meeting, shall have approved the convention with the Government, and as soon as the necessary arrangements shall have been completed. That convention will also require, of course, the sanction of the States-General. It provides that the State shall pay the Dutch-Rhenish Railway a sum of 30,467,568 guilders (about $12,700,000), being the amount of its paid-up capital, together with 5 per cent. interest on that sum, from the 1st of May until the day of payment. As the concession of the railway company terminates in 1898, the Government agrees to pay the shareholders, by way of compensation for the earlier acquisition than the State was entitled to, a further sum of 6,808,928 guilders (about $2,870,000). Some managers and officials will be pensioned or otherwise compensated, whilst the others will pass into the service of the State Railways Company. The Dutch Railway (Amsterdam, The Hague, Leyden, Rotterdam) has also been acquired by the State, and this consolidation of interests will, it is expected, not only conduce to more economical working (the excessive rivalry of the two undertakings acquired being a very expensive one), but also to more harmony and a closer study of public wants and public comforts. Already various improvements are spoken of, in the service of the trains and in their connections at important junctions.—*Industries.*

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

American Midland.—A. A. PURMAN, Vice-President and Attorney for the State of Indiana of the American Midland Railway, confirms the report that ANDREW CARNEGIE has got control of this road. It is stated that he has also secured control of the Pittsburg & Western Railway and the Cleveland & Western Railway, and is negotiating with the newly-chartered New York, Fort Wayne & Chicago, which is to parallel the Pittsburg, Fort Wayne & Chicago from Fort Wayne to Chicago. This secures him a line from Pittsburg to Chicago 38 miles shorter than the Pennsylvania, over which he will transport his coke, coal, and iron.

Dexter & Piscataquis.—J. B. PEAKS, of Dover, Me., sends us the following statement in regard to this enterprise.

The road runs through the towns of Dexter, Sangerville, and Dover to Foxcroft, a distance of 17 miles. The work is generally good; maximum grade 80 ft. per mile and maximum curve 5°. The road is nearly completed and will be opened for traffic Dec. 1. The road is laid with 67 lb. steel rail. There is one 3-span iron bridge across the Piscataquis river. About 200 men are now at work on the remaining 2 miles north of the River. The road is entirely a local enterprise, projected and carried through by the people of Dover and Foxcroft.

Delaware River & Lancaster.—The new line from Phœnixville, Pa., to French Creek is rapidly approaching completion. Grading has been completed nearly to Kimberton. Surveys have been made for the further extension of the road.

Housatonic.—The annual report of this company for the year ending June 30, 1889, shows the following results:

Gross earnings	$1,159,347 12
Operating expenses	711,071 83
Net earnings	$448,276 29

Profile & Franconia Notch.—It is stated that this road will be extended from Bethlehem Junction, N. H., to a connection with the Maine Central R. R. during the coming season.

Baltimore & Ohio.—This company has given an order that the double tracking of the Metropolitan branch shall be resumed at once. The new track from Knowles to Rockville, Md., will be begun immediately, and this, when completed, will give a double track from Washington to Gaithersburg, a distance of 22 miles.

Brockville, Westport & Sault Ste. Marie.—Contracts will soon be let for the extension from Westport to Sharbot Lake, Ont., a distance of 18 miles.

Cleveland, Cincinnati, Chicago & St. Louis.—Preliminary surveys have been completed for a line from Columbus to Springfield, O.

New Brunswick.—At a meeting of the stockholders recently held the following directors were elected: Sir DONALD SMITH, Sir GEORGE STEPHEN, ROBT. MHEIGHEN, of Montreal; E. R. BURPEE, Bangor; C. W. WELDON, M. P., and JOHN MCMILLAN of St. John, SAMUEL THORNE, J. KENNEDY TOD, D. WILLIS JAMES, H. A. NORTHCOTE, and JOHN S. KENNEDY, of New York. At a subsequent meeting of the directors Sir GEORGE STEPHEN was elected President and J. KENNEDY TOD of New York Vice-President, and F. W. CRAM, General Manager.

Western Maryland.—It is stated that this company is considering the building of an extension from Williamsport, Md., along the Cherry River to Cherry Run, W. Va., to obtain a connection with the Baltimore & Ohio R. R. at that point.

Pennsylvania.—This company has advertised for proposals to grade and build pile trestling for a single-track branch railway between Girard Point and Broad St., in the city of Philadelphia. The proposals must state price per cubic yard for embankment, including the excavating, hauling and depositing of material in place and price per lineal foot for pile trestle.

Baltimore & Ohio.—Work is progressing rapidly on the line to New York. The Arthur Kill bridge has been completed and the entire route graded, and tracklaying is now in progress to be completed by Nov. 15.

New York Central & Hudson River.—This company has concluded a contract with the city of Buffalo, N. Y., whereby it agrees to raise all grade crossings in that city above or lower than below the streets. It is said that the total expenditure will be about $3,000,000 and that it will take nearly two years to complete the work.

Projects and Surveys.

Poughkeepsie & Southeastern.—H. F. KEITH, of 54 Market St., Poughkeepsie, N. Y., sends us the following concerning this enterprise:

The road is to run from the terminus of the New York & Massachusetts Ry., at Poughkeepsie, to Hopewell Junction, a distance of 11.2 miles. The line has been located ready for construction. The work is generally light; maximum grade .01 per cent., and maximum curve 6°. The road will do a general local business, and it is thought that a large through traffic will be obtained via the Poughkeepsie Bridge, and the New York & New England, the Newburg, Dutchess & Connecticut, and the New York & Massachusetts railways. E. L. DYWER, of Poughkeepsie, is President and GEO. S. BOWEN is General Manager.

Kennebec Central.—At a meeting of the stockholders recently held it was voted to increase the capital stock of this company to $400,000, for the purpose of building some extensions not included in the original survey. A preliminary contract for grading the road was also entered into.

Chicago, Muncie, Richmond & Cincinnati.—Incorporated in Indiana to build a line of railway from a point on the Cincinnati, Wabash & Michigan R. R., between Jonesboro and Fairmount, in Grant County, Ind., to Cincinnati, O. The directors are D. J. MACKEY, WILLIAM HELLMAN, JAMES L. MACKEY, E. B. MORGAN, W. J. LEWIS, G. J. GRAMMER, and EDWIN TAYLOR.

Beauharnois Junction Branch.—This company will apply to the next Quebec Legislature for a charter to build a railway from a point on the Beauharnois Junction R. R. to a point near Blisson, Que., on the St. Lawrence River.

Lackawanna & Montrose.—The directors of this company, whose incorporation was noted last week, are: W. D. LUSK, Montrose, Pa., President: W. J. MULFORD, A. L. BEACH, W. H. JESSUP, W. W. WILLIAMS, H. P. READ, W. G. PARKE, J. GRIFFIS, R. M. BOSTWICK, E. P. POPE, J. R. COOLEY, T. J. DAVIES, and DANIEL SAYRE, all of Montrose.

Chicago, Greenfield & Cincinnati.—Incorporated in Ohio to build a line of railway from Rushville to Noblesville, with a branch to Anderson, Ind., opening up a new route through the Indiana natural gas fields.

Imperial & Frankfort Springs.—A project is on foot to build a railway from Imperial, Pa., via Murdocksville to Frankfort Springs, Pa., 24 miles. A large amount of stock has already been subscribed. C. H. ANDREWS, W. C. ANDREWS, and WM. MCCREERY are interested.

United Terminal.—This company has been incorporated in Ohio with a capital stock of $20,480.

SOUTHERN.—Existing Roads.

Louisville, New Orleans & Texas.— Engineers are reported at work locating an extension of the Tallahatchie branch of this road, up the Yazoo and Tallahatchie Rivers, via Shellmound and Winter City, Miss., to either Clarksdale, Coahoma, or Lula, where connection will be made with the main line. About 20 miles of the line is already located from the south end, and contracts will be let as soon as the right of way has been obtained.

Norfolk & Western.—This company has commenced the construction of a branch from a point about 7 miles from Norfolk, Va., to Burton's Point. —— Surveys are being made for a branch from Salem, Va., to iron mines owned by the Salem Furnace Co., about 6 miles.——It is reported that the Saltville branch will be extended 12 miles up Rich valley.

Columbia, Newberry & Laurens.— About 21 miles of this road from Columbia, S. C., to Little Mountain are graded, and work is being pushed on the remaining 22 miles. Tracklaying will begin at once on the portion now graded.

Augusta, Tallahassee & Gulf.—Work is in progress between Appalachicola and Tallahassee, Fla., under the direction of the contractors, R. P. McCormick & Co., of Kansas City, Mo. The piling for the trestle across the Ocklockny River, is nearly completed.

Brunswick, Athens & Northwestern —A large force of men are now grading this line and it is stated that tracklaying will commence in about two months. The road is projected to run from Brunswick, Ga., to Knoxville, Tenn.

Louisville, Hardinsburg & Western.—It is expected that this road will be in operation between Cloversport and Hardinsburg, Ky., by Oct. 20.

Cape Fear & Yadkin Valley.—It is thought that the line from Wilmington to Fayetteville, N. C. will be completed by Jan. 1, 1890. Over 30 miles of track are now laid from Wilmington north, and the remainder of the line to Fayetteville is graded and tracklaying is in progress. After the completion of the road to Fayetteville the company proposes to build a branch from Wilmington to Southport, N. C.

Rome.—A bill has recently passed the Georgia Legislature authorizing this road to make an extension from Rome to the Alabama State line. It is also announced that the road will be extended from Kingston east via Gainesville and Athens, Ga., and possibly to Port Royal, N. C.

Atlantic Coast Line.— At a meeting of the people living along the proposed route of the Scotland Neck extension of this road, recently held, the right of way was voted from Greenville to Kinston, N. C.

Birmingham, Sheffield & Tennessee River. — This company is making preparations to build several branch roads to mines being opened in Franklin County, Ala.

Richmond & Chesapeake.— At the annual meeting of the stockholders, held Oct. 10, the following officers were elected: CHAS. W. MACKAY, President; CHAS. E. BELVIN, Vice-President; M. B. PORTIAUX, Secretary; and H. R. BALTZER, Treasurer. This company proposes

to build a line of railway from Richmond, Va., to Wicomico Wharf, about 50 miles. The principal work of the road will be a tunnel under Eighth St. in Richmond, about ¾ mile long. A small amount of work has been done on this tunnel, and it is stated that the company will invite the railway companies now centering in Richmond to aid in constructing it.

Atlantic & Danville.—The city of Danville, Va., has voted $150,000 in aid of this enterprise. The conditions on which the money was voted were given in our issue of Sept. 21.

Wilmington, Onslow & East Carolina.—This road has been graded from Wilmington to a point near Chapel Pond, Pender County, a distance of 20 miles. Work is progressing rapidly.

Projects and Surveys.

Atlantic, Thermal Belt & Knoxville.—C. L. KINGSLEY, of Raleigh, N. C., Chief Engineer, is making the surveys for this road, which is the new name of the Camden, Chester & Gaffeney R. R. The road will run from Florence, S. C., to Gaffeney, S. C.

Montvale.—It is announced that sufficient money has been raised to build this road, which is to run from the Knoxville Southern R. R. to Montvale with a branch to Seiverville and Newport, through the lumber, granite, marble, coal, and iron belt of Tennessee.

Cape Fear & Cincinnati.—The surveys for this road, which is projected to run from Wilmington to Southport, N. C., 25 miles, have been completed. FRANK BROWN, of Baltimore, Md., is President.

Selma & Bessemer.—Incorporated in Alabama to build a line of railway from Selma, through the counties of Dallas, Perry, Bibb, and Jefferson, to Birmingham. The capital stock of $100,000 has all been subscribed. The directors are: H. L. MCKEE, A. W. CAWTHON, B. S. BIBB, H. D. L. MALLORY, SOL KOHN, T. SCHWARZ and R. M. NELSON.

Blue Mountain Mineral.—Announcement is made that arrangements have been completed for the early commencement of construction upon this road. The road is projected to run from Anniston, Ala., to a connection with the East & West Railway of Alabama, a distance of 20 miles. A dummy line will also be put in between Anniston and Jacksonville. J. A. GABOURY, of Jacksonville, Ala., is President.

West Virginia & Pennsylvania.—C. E. GALLAGHER, Chief Engineer, has completed the survey of this road from Rowlesburg, W. Va., to the Pennsylvania State line, a distance of 33 miles. The route in Pennsylvania cannot be surveyed until the northern terminus of the road has been determined. The company is now considering the comparative advantages of Fairchance, Uniontown, and Dunbar. The route is through a region rich in timber and minerals. A tunnel will be necessary through the mountains between the State line and the northern terminus.

Gurley's & Paint Rock.—Chartered in Alabama to build a railway from the State line, in Jackson County, down the Paint Rock Valley to Guntersville, Ala.

Troy & Pensacola.—A project is on foot to build a railway from Troy, Ala., to Pensacola, Fla., a distance of 120 miles.

Mount Pleasant & Seaview City.—Rapid progress is being made on the surveys for this South Carolina road. The road starts from a point on the western shore of Hog Island nearly east from Calhoun St., Charleston, and runs east and south through Mount Pleasant to the eastern point of Sullivan's Island, a distance of about 8 miles. A ferry will connect the western terminus of the road with Charleston. It is stated that the road will be built at once.

NORTHWEST.—Existing Roads.

Yankton, Norfolk & Southwestern.—This company has negotiated its bonds of $18,000 per mile with the Atlantic Trust Co., of New York. Nearly all of the right of way has been obtained, and construction is to commence at once.

Canadian Pacific.—Mann & Holt, contractors on the Qu' Appelle, Long Lake & Saskatchewan R. R., expect to have their contract finished in about three weeks. The road is already constructed 35 miles and considerable grading has been done on 45 miles more of the line.

Chicago & Northwestern.—Work is progressing rapidly on the line from Evanston to Montrose, Ill., 7½ miles, and it is expected that it will be completed by the middle of November.

Waukegan & Southwestern.—All of the right of way has been secured for this road, and construction is now in progress. About 6 miles of track have already been laid. It is expected that the line will be completed and in operation by Jan. 1, 1890.

Abbotsford & Northeastern.—Grading has been completed on this Wisconsin road and tracklaying is now in progress.

Port Arthur, Duluth & Western.—Nearly 10 miles of this road has been graded ready for the rails and 10 miles more will be finished within one month, and the road completed to Keministiqua, by Dec. 1, 1889.

Fort Madison, Western & Birmingham.—At a meeting of the creditors of the Fort Madison & Northwestern Ry. Co., recently held, articles of reorganization were drawn up under the above name. The object of the new company is to purchase the Fort Madison & Northwestern Railway, running from Fort Madison to Collet Station, Ia., 45 miles, and to extend it to Ottumwa, Ia.

Canadian Pacific.—This company will do a large amount of work in the way of improvement between Port Arthur, Ont., and Rat Portage during the coming winter. The work embraces the replacement of all bridges with solid masonry, and doing all necessary rock cutting to straighten the line between the points named. Alex. Livingstone has the contract and will begin work at once.

Sault Ste. Marie & Southwestern.—This company, which proposes to build a railway from Rhinelander, Wis., to Omaha, Neb., 525 miles, has asked the city of Rochester, Minn., for $35,000 in aid of the enterprise, promising to have the road completed to that place by Dec. 1, 1891. The road is now completed from Fairchild to Osseo, Wis., 14 miles.

Duluth, Crookston & Northern.—The contractors for building this road from Fertile to Crookston, Minn., 23 miles, are Evans Bros., of Hamlin, Minn., and not Winston Bros., of Minneapolis, as noted in our issue of Sept. 28. Tracklaying has been commenced, and it is expected the line will be in operation by Oct. 25.

Great Northwest Central.—The contractors report that work is making satisfactory progress on this road. Tracklaying has been commenced and will be pushed ahead as rapidly as material arrives. The contract for building station houses, round houses, tanks, etc., has been let to ALD. BELL, of Winnipeg, Man., and work will begin at once.

Milwaukee, Menominee Falls & Western.—This line has been located from Granville to Sussex, Wis., a distance of 10 miles, and is now under construction. Three miles of the grading is completed. The road is being built to open up the extensive limestone quarries along the route. The Hadfield Co., of Waukesha, Wis., are the contractors and WILLIAM POWRIE, of Sussex, Wis., Chief Engineer.

Burlington & Missouri River.—This company has laid track from Alliance, Neb., to the Wyoming coal fields, 160 miles, and from Culbertson to a point northwest, 9 miles, since Jan 1, 1889.

Projects and Surveys.

Midland Pacific.—The city of Sioux Falls, Dak., has voted $120,000 of bonds in aid of this enterprise. The company propose to build a railway from Sioux Falls to Puget Sound.

Sioux Falls, Yankton & Denver.—The city of Sioux Falls, Dak., has voted $60,000 of bonds in aid of this road.

Rochester & St. Paul.—This company has asked the city of Rochester, Minn., to vote $45,000 in aid of a road to be built from Rochester to Eden, Minn. The road is to be completed by Sept. 1, 1890.

Sault Ste. Marie & Hudson Bay.—This company noted in our issue of Oct. 5 as having applied to the Dominion Government for a charter to build a railway from Sault Ste. Marie to Hudson Bay, has been incorporated under the above name. The road will be about 375 miles long. Among those interested are: WM. BELL, JOSEPH COZENS, and JOHN MCKAY.

Huron, Chamberlain & Black Hills.—E. T. HARMSTON, Chief Engineer, has completed the survey for this road, from Chamberlain to Huron, Dak. Maps and profiles of the route are now being made.

Winnipeg & Southeastern.—It is stated that arrangements have been made for the early construction of this road. The contract for grading 30 miles from Winnipeg southeast has been let to Sinclair & Flannagan and work is to begin at once. The road will connect at the International boundary with a line running northwest from Duluth, Minn.

Sioux Falls & Denver.—At a meeting of the directors recently held the following officers were elected: President JAS. H. DRAKE, of St. Paul, Minn., Vice-Pres, M. GILLEAS of Dubuque, Ia., General Manager, J. L. TURNER, and Secretary and Treasurer, C. O. BAILEY. It was determined to begin securing right of way at once, and to build the road outside the corporation limits of Sioux Falls, Dak., this fall.

Marquette & Iron Range Construction Co.—This company has filed articles of incorporation in Illinois to build a railway from Ishpeming to Marquette, Mich. Among the incorporators are FRANK BUTTERWORTH and E. D. CUMMINGS.

SOUTHWEST.—Existing Roads.

Missouri Pacific.—The Fort Scott Terminal, the Fort Scott & Southern, and the Fort Scott & Western railway companies have been incorporated in Kansas in the interest of this company. The new lines are being built to connect the Missouri Pacific lines in southern Kansas with each other and with the main line. One of the lines will be built southwest to connect with the Wichita, Fort Scott & Western R. R., and one will be built west to connect with the Kansas, Nebraska & Dakota R. R.

Dallas, Pacific & Southeastern.—A press dispatch from Dallas, Tex., states that the first 72 miles of this road has been nearly all graded and will soon be ready for the track. As no rails can be obtained before Dec. 15 on account of the pressure on the mills, it is probable that tracklaying will not commence before January.

Chicago & Alton.—It is announced that this company will build a road from Lacon, Ill. to Glasgow, Mo., to shorten its line betweed Chicago and Kansas City.

Red River, Sabine & Western.—About 10 miles of this Texas road have been graded from Nacogdoches east and a large force of men and teams are now pushing work.

Little Rock & Memphis.—Efforts are being made by the citizens of Paris, Tex., Little Rock, and Hot Springs, Ark., to have this company extend its line from Little Rock west to Texas.

Kansas City, Watkins & Gulf.—The survey for this Louisiana road has now been completed from Lake Charles to Alexandria. The Chief Engineer, P. H. PHILBRICK, reports a very favorable route.

Projects and Surveys.

East End Terminal & Depot Co.—A company by this name is to be incorporated to provide terminals for all railways now entering St. Louis, Mo., and all that may enter in the future, together with a belt line, switches, warehouses, and all the necessary improvements for affording the railroads first-class facilities. The incorporators and directors are RICHARD ENNIS, MARCUS BERNHEIMER, JOHN MAFFIT, CARLOS GREELY, GILES E. FILLEY, E. A. HITCHCOCK, ALVAN MANSUR, E. O. STANARD, and HAMILTON DAUGHADAY.

ROCKY M T. AND PACIFIC.—Existing Roads.

Denver & Rio Grande.—The following are the bidders for grading on the Rio Grande Junction Ry., running from Rifle Creek, to Grand Junction, a distance of 64 miles: Corey Bros. & Co., Ogden, Utah; Carliles & Weitbra, of Pueblo, Col.; Ballard & Rice, J. R. De Remer, J. A. Mc Murtrie, Orman & Crook, Moore & Clough, D. D. Streeter & Co., Homan, Bell & Co., Levy, Moore & Co., Scullin & Stency, W. C. Bradbury; all of Denver; F. H. Fuller & Co., Omaha, Neb.; Kilpatrick Bros. & Co., Beatrice, Neb; Douglas Bros. & Co., of Denver and Mallory, Cushing & Co., of Omaha, Neb. The contract was awarded to Corey Bros. & Co., of Ogden. The road is to be completed by April 1, 1890. The contractor's estimates call for the following work: earth excavation, 550,000 cu. yds. loose earth, 380,000 cu. yds.; solid rock, 255,000 cu. yds.; haul, 600,000 cu. yds.; rip-rap, 20,000 cu. yds.; tunnel 1,200 lin. ft. Besides this, there will be about $40,000 worth of work to do on a toll road.—The Colorado Short Line R. R. Co. has been incorporated in the interest of this company to build a railway from a point on the D. & R G. R. R. near the Arapahoe county line between Littleton and Acequia; thence in a southwesterly direction up the valley of the Platte River to Lidderdall on the line of the Colorado Midland road in Park County; thence west and southwesterly to a point on the Rio Grande in Chaffee County at or near the town of Buena Vista; thence west to Grand Junction in Mesa County; thence westerly to Salt Lake City, Utah; thence west through Utah and Nevada to Elko, on the Central Pacific road. The principal office of the company will be in Denver.

The contracts will be let as soon as the necessary arrangements can be completed, and work will be begun at once. The company has laid tracks from Glenwood to Rifle Creek, 26 miles; from Spinero to Lake City, 36 miles; and from Ridgway to Aberdeen, 5 miles, since Jan. 1, 1889.——The contract for the road from Manatou, Col., to the summit of Pike's Peak, 9 miles, has been let to B. Lantry & Sons.——A press dispatch states that the work of construction will soon commence for a line from Long's Cañon south, via Los Vegas, N. M. and Valentine, Tex., to Laredo, Tex.

Seattle, Lake Shore & Eastern.—R. H. TALCOTT, of Seattle, W. T., has sent us the following data concerning this enterprise.

About 150 men are now at work on the branch from Snohomish to the International boundary, a distance of 82½ miles. The line is already built from a point on the main line 23½ miles from Seattle to Snohomish 20 miles; maximum grade 1.5 per cent. and maximum curve 6°. There will be bridges across the Stillaguamish and Skagit Rivers. The principal business of the road will be in logs and timber at present. Track is to be laid as soon as grading has progressed sufficiently. No track has been laid this year. It is expected that the road will be completed by Jan. 1, 1891. The branch when completed will connect at the International boundary with a branch being built from Mission Station south by the Canadian Pacific. On the eastern extension 45 miles have been built from Spokane Falls westward and 23½ miles of main line from Seattle east with branch toward Snoquatmis about 40 miles long. The route of the main line is yet uncertain, but surveys have been made over the Cascade Range via Cady's Pass.

Santa Fé Southern.—Chief Engineer COLEMAN of this road has completed the survey for the line from Santa Fé, N. M., to the San Pedro mines, a distance of 46½ miles. The route passes through Cerillos and Golden.

California & Nevada Narrow Gauge.—A press dispatch from California states that 70 teams and a large force of men are at work on the extension to Charles Hill, where a tunnel will be built.

Union Pacific.—The report that this company has transferred a large number of men to Milford, Utah, and will begin construction on a line from that place to southern California immediately, is going the rounds of the western papers.—A dispatch from San Diego, Cal.

Sewerage of Jackson, Tenn.—The following proposals have been received. J. D. COOK, of Toledo, O., is Consulting Engineer, and L. E. CHAPIN, Associate Engineer. Laying pipe only, and including all labor and material except pipe: Geo. L. Gillespie, Chattanooga, Tenn.: 80 cts. for 20-in., 62 cts. for 14-in., 57 cts. for 12-in., 50 cts. for 8-in., $13,548.50. Tenney, Crass & Montgomery, Decatur, Ala., 55 cts., 87 cts., 82 cts., 69 cts., $17,751.50. The Rockwell Machine Co., of Sandusky, O., bid 2.48 cts. per lb. for all iron.

Bidders.	Price per lin. ft., sewer pipe furnished and laid complete, 20-in.	14-in.	12-in.	8-in.	Totals pipe & laying.	Manholes, each complete.	Flush tanks compl'te with brick basin.	Furnishing & setting fl'sh tank only.	Brick masonry manholes.	Concrete per cu. yd.	Cast-iron covers per lb.	Outfall pipe compl'te	Lumber per M. ft. B. M.	Total based on specification quantit's and 500 ft. 12-in. pipe extra.
	$	$	$	$	$	$	$	$	$	$	cts.	$	$	$
Gillespie & Lee, Chattanooga, Tenn	1.50	1.30	1.15	0.95	27,057.50	50	125	.....	.....	.....	.....	252	.....	31,284.50
Whitsett & Adams, Nashville, Tenn	1.35	1.57	1.49	1.13	30,615.00	.....	.....	45	20	8	14	108	20	36,510.80
Scovel & Irwin Const. Co., Nashville, Tenn	.....	.....	.....	.....	.....	.....	.....	Lump	.....	bid	.....	.....	.....	37,341.00
Geo. L. Gillespie, Chattanooga, Tenn	1.55	1.05	0.85	0.68	19,786.00	50	.....	65	17	5	3	100	15	24,967.50
Tenny, Crass, Head & Montgomery, Decatur, Ala.	1.35	1.27	1.09	0.81	22,862.00	54	.....	91	20	7	2½	.....	20	29,161.50
Nelson & Cleary, Chicago, Ill	.....	.....	.....	.....	.....	.....	.....	Lump	.....	bid	.....	.....	.....	31,450.00
Approximate quantities	1,950 ft.	900 ft.	4150 ft.	18700 ft.		73	6	6	140 M.	76 yds.	32,400 lbs.			

For furnishing pipe only.

Bidders.	20-in.	14-in.	12 in.	8-in.	12 x 12 x 8	8 x 8 x 6	8-in. plugs.	6-in. p lugs.	Total for pipe and specials.
	cts.	cts.	cts.	cts.	$ cts.				$
P. Bannon, Louisville, Ky	75	41	28½	15	1.10	55	8	6	6,283.45
W. W. Hains, " "	67½	39	27½	13	1.20	60	5	5	5,750.00
Lookout Sewer Pipe Co., Chattanooga, Tenn	73¼	40⅝	27⅝	14⅝	1.24⅜	65¼	5	5	6,138.98
Approximate quantities	1,950 ft.	900 ft.	4,150 ft.	18,700 ft.	100	670	100	670	

states that a mass meeting was held at that place recently to take measures to secure the line for San Diego. It was proposed to turn the San Diego, Cuyamaca & Eastern R. R., now completed, from San Diego to the El Cajou Valley, and land valued at $1,000,000 into the hands of the Union Pacific Company on condition that it build such a line.

Wyoming, Salt Lake & California.—About 175 teams and a large force of men are now at work on the line between Park City, Utah, and Evanston, Wyo., and it is intended to have this division completed by Dec. 1, 1889. From Evanston east the survey has been completed to within 30 miles of the Chicago & Northwestern R. R., at Sweetwater Pass. Between Park City and Salt Lake, a large force is at work grading the line along Emigration Cañon. There will be three tunnels on this division of the line, the longest of which is 3,500 ft. Construction will soon commence on the line from Lake Point, Utah, to the Nevada State line, a distance of 165 miles. The company expects to have the entire line completed by June, 1890. At a recent meeting of the stockholders the following directors were elected: JAMES E. FULTON, THOS. W. BATES, W. C. HALL, R. GARDNER, JAMES M. KENNELLY, EDW. E. RICH, W. P. NOBLE, L. C. TRENT, O. L. SPROAT, M. E. HOPKINS, L. C. KARRICK, GEORGE O. NOBLE, JAMES A. BOLEN, of Kansas City, NEWELL BEMEN, of Evanston.

Projects and Surveys.

Idaho Springs, Spring Gulch & Chicago Creek.—Chartered in Colorado to build a railway from Idaho Springs to a point near Larmartine mine. Among the incorporaters are: F. F. OSBISTON, W. A. HAMILL, and THOS. CORNISH.

FOREIGN.

Sonora, Sinaloa & Chihuahua.—LOREN MILLER, of Deming, N. Mex., sends us the following information concerning this enterprise:

The road is to run from Deming, New Mexico, via Lake Palomas, Asuncion, Corralitos, Casas Grandes, El Valle, and Santa Ana to Guerro, and thence east to Chihuahua and west to Guaymas and Topolobampo Bay. The total length of the road will be 1,500 miles; all in the States of Sonora, Sinaloa, and Chihuahua, Mexico. The work will be very easy most of the distance. There will be one loop and perhaps one tunnel. The principal business of the road will be in ores, bullion, agricultural products, pine timber, mahogany, rosewood, and other ornamental woods. The road is subsidized by the Mexican Government to the amount of $13,000 per mile, which will be paid for every mile completed after the first 6¼ miles. The company has also secured other valuable concessions in the shape of lands, franchises, right of way, etc. About 150 miles of the road has been surveyed at each end and contracts let. The principal contractors are Elliott, Huss & Co., of Chicago, Ill., and Deming, N. M. About 30 miles have been graded from Deming, N. M., south and an equal distance from Guaymas east and about 6 miles west from Chihuahua. Tracklaying will commence at Deming in October. Four miles of track have already been laid from Chihuahua. The portion of the road in the United States is being built under the name of the Deming, Sierra Madre & Pacific R. R.

RAPID TRANSIT.

Cable Railways.—***Providence, R. I.***—The construction of the new cable line has been commenced.

Cleveland, O.—The Superior St. Ry. Co. is building its line on Superior St.

Elevated Railway.—***Kansas City, Mo.***—The Interstate Rapid Transit Co., which operates an electric road between Kansas City, Mo., and Kansas City, Kan., has been put in the hands of a receiver. The company thinks that the road will be prosperous in the future Mr. D. M. EDGERTON is the receiver.

Dummy Lines.—***Orangeburg, S. C.***—The Orangeburg St. Ry. Co. has purchased a dummy engine for experiment.

Augusta, Ga.—The Richmond County Belt Line Co. has been organized as follows: President, CHARLES A. ROBBE; Secretary, JAMES M. JACKSON. The road will be built by JOHN A. BROWN, of Kansas City.

The Sprague Electric Co. has orders to equip the Piqua, O., street railway, 3 miles long, 4 cars; the South Nashville, Tenn., street railway, 5.6 miles long, 8 cars; and the street railway between Florence and Fiesole, in Italy, 5 miles, 12 cars.

Electric Railways.—***Beverly, Mass.***—The Beverly & Denver road has been opened. It is operated by storage battery cars built by the Union Electric Car Co., of Boston.

Baltimore, Md.—The Baltimore & Hamden road, which was equipped with one of the earlier electric systems in 1885, has abandoned electricity and decided to return to horse power.

Richmond, Va.—The Union Electric Ry. Co. will abandon its present electric system, and use either horses or an improved electric system in the future.

Cincinnati, O.—The Cincinnati Incline Plane Ry. is now in successful operation. The road is about 6 miles long, equipped with 20 cars. It is on the Sprague system, with overhead wires. The cars are run by electricity to the incline, where they are hauled up on an elevator platform, and connect with the electric system again.

Denver, Col.—The Colfax Ave. Electric Ry. Co. has been incorporated to build a line 6 miles long, from the terminus of the Tramway Cable Co's. Colfax Ave. line.——Col. A. C. FISK is interested in a project for an electric line in the southwest section of the city.

Toronto, Ont.—The Metropolitan St. Ry. Co. has applied for power to use electricity.

Sioux Falls, So. Dak.—Grading is in progress on the line of the South Dakota Rapid Transit Ry. Co., an electric road 7.4 miles long from the city to the stone quarries and East Sioux Falls. President, W. R. KINGSBURY; Secretary, W. S. WELLEVER; Engineers, Jackson & Vause.

Street Railways.—***Hartford, Conn.***—The street railway to East Hartford has been opened.

Fishkill, N. Y.—The Board of Trade proposes to build a street railway between Fishkill Landing and Matteawan. A horse road would cost about $21,178, and an electric road $32,429.

New York, N. Y.—The Twenty-eighth and Twenty-ninth Sts. Crosstown Ry. Co. cannot obtain a permit to lay its tracks unless it agrees to use the rail approved by the Commissioner of Public Works.

Rochester, N. Y.—The Crosstown St. Ry. Co. has let the contract for the construction of its road to Thomas Murray & Co., of Jersey City, N. J.

Buffalo, N. Y.—The Buffalo Electric & Cable St. Ry. Co. has been incorporated to build about 50 miles of street railway. Capital stock, $1,500,000. The incorporators are: DANIEL O'DAY, DANIEL N. LOCKWOOD, JAMES AMM, GERHARDT LANG, HENRY ALTMAN, THOMAS F. RAMSDELL, JAMES ADAMS, J. P. DUDLEY, and GEORGE F. SOUTHARD of Buffalo, and WM. L. ELKINS and PETER B. WIDENER, of Philadelphia. The company will be given a hearing by the Council on Oct. 26.

Fayetteville, N. C.—A street railway is projected. Address J. T. DENNY.

Decatur, Ala.—A company has been organized to build a belt line at a cost of $75,000.

Cleveland, O.—Bids for the right to build and operate a line on Scranton Ave. will be received by H. H. BURGESS, City Clerk, until Oct. 24.

Pontiac, Mich.—A street railway is projected from the station of the Detroit, Grand Haven & Milwaukee Ry. along Main and other streets.

West Duluth, Minn.—The West Duluth St. Ry. Co. has been granted an exclusive franchise. The directors are W. H. H. STOWELL, C. E. SHANNON, WM. E. TANNER, R. H. HARRIS, and W. P. HURLBUT.

Des Moines, Ia.—The Des Moines St. Ry. Co. has been organized, and has absorbed the Des Moines Electric Ry. Co. and the Des Moines & Sebastopol St. Ry. Co. President, J. S. POLK; Secretary and Genral Manager, GEO. B. HIPPEE.

Argentine, Kan.—A street railway franchise has been granted to Norton, Thayer & Co.

Nevada City, Cal.—A street railway to Grass Valley is projected by MATHIEU SCHRAMM.

Salem, Ore.—The Capital City St. Ry. Co. has been incorporated, with a capital stock of $25,000.

HIGHWAYS.

Florence, Ga.—The following proposals for constructing a road have been received by Col. J. W. SCULLY, U. S. A., Atlanta, Ga.; Thomas E. Wallace, Wilmington, N. C., $11,912.43; W. H. Sullivan, Great Falls, Md., $14,137.69; Wm. McConnell, Atlanta, Ga., $14,797.79; J. S. Beck, Florence, S. C., $19,000. The contract was awarded to Thomas E. Wallace.

Maryland's Roads.—In its report to the court, the Grand Jury for St. Mary's County, Capt. GEORGE THOMAS, foreman, draws a graphic picture of the wretched methods for repairing public roads, which exist, not only in St. Mary's, but in other counties of the State. The report says:

It is unnecessary to say that the public roads are in a shameful condition. There is scarcely a provision of the law in this matter that is or has been for years past observed by those who have had charge of the same. The law requires that they shall be kept open and in proper repair for a certain width, and yet for miles in many sections where there is much travel the roadway is not one-third the legal width and so narrow that a vehicle cannot possibly pass one preceding it without a stoppage of one in front. The law requires that the public highways shall be kept free from obstructions, and yet the overhanging branches in many places are to a great degree obstructive, injuring vehicles with tops using the same, and exceedingly trying to all in rainy weather. The law provides for district road commissioners, thus laying the groundwork of a proper system. No such district commissioners have ever been appointed. The law contemplates a general system of rules and regulations covering the entire county. None such have ever been framed. But one feature of the road law has claimed of successive boards the fullest obedience, and that is the privilege of taxing the people to the amount of $5,000 per year and sometimes more on this account. The entire amount drawn is practically squandered, not even representing in work actually done 50 per cent. of that paid for, and of the work actually done, for lack of system and proper administration, scarce 10 per cent. is of real benefit. Road agents and supervisors are selected to reward party service, and to meet party demands are multiplied tenfold, to the great damage of the public interest. Whether this state of things can ever be remedied so long as the control of the roads remains as at present is questionable, for change of party control and of individual membership has in the past brought no change in the miserable method of pensioning party workers upon the taxpayers in pretended effort to keep in order the public highways.

A radical change is needed, looking to permanent, substantial work. As a first step the roads should be made of proper width, they should be thrown up in the center and properly drained, and drain pipes should be used when possible, and this under some general and intelligent system, uniform for the county. In any event, it would seem that there should be a change made in that feature of our local laws requiring the road levy to be left in the hands of the several collectors, to be by them paid over to the several road supervisors. The road fund should be paid over to some one designated official in order that prompt payment of such accounts may be made, so that, whatever system may be adopted, the work may be done under a cash system. Payments for road work as now made involve great delay in the settlement of accounts, with all its attendant evils, to the great detriment of the public interests.

CONTRACTING.

Sewers.—***Portchester, N. Y.***—The contract for the construction of the Gracechurch St. district of the sewerage system has been awarded to John O. Merritt, of Portchester: Furnishing and laying pipe, $1.65 per ft. for 20-in., $1.51 for 18-in., $1.22 for 15-in., 91 cts. for 12-in., 79 cts. for 10-in., 71 cts. for 8-in., 54 cts. for 6-in., 34 and 24 cts. for 8 and 6-in. sub drains; $40 each for manholes, $85 for catch basins, $39 for overflows, $4.90 per cu. yd. for rock, $48 and $44 for VanVranken and Rider flush tanks, $7.50 for concrete. Intercepting sewer: 68 and 55 cts. per ft. for 10 and 8-in. iron pipe, 14 cts. per cu. yd. for excavation, 16 cts. for embankments, 48 cts. per ft. for 10-in. piles. Total, $29,952.89. The other bidders were: Haskins & Culver, New York, $30,678; Henry A. Warner, New Haven, Conn., $4,955.17 per pipe; W. F. McCabe, Mamaroneck, N. Y. $60,449.95; Daniel Murray Portchester, $36,928.51; A. Brazos & Sons, Middletown

Conn., $68,662.40; Adam Miller, Saratoga, N. Y., $30,149.19. The engineer's estimate was $31,365.80, or $34,355.06, including a driveway over the sewers to the proposed disposal works.

Cincinnati, O.—The following are the totals of bids for the construction of trunk sewers in Walnut Hills: Gilbert Ave.: Folz & Jonte, $13,559.50; Henry Frank, $11,-202.50; B. Strack, $16,608.55; Henkel & Brehm, $10,215.75; Daniel Minahan, $12,575.40; George H. Meyer, $11,805.50; P. Murray & Son, $11,007.15; Henry McErlane, $11,198.75; M. Peter & Son, $12,484.80; A. B. Ashman, $14,340.25.

From corporation line to Gilbert Ave.: Henkel & Brehm, $24,364.25; W. C. Murray, $26,449; B. Streck, $29,-887.65; Folz & Jonte, $24,954.50; M. Peter & Son, $23,768.40; Dan'l Minihan, $19,192.85; Henry McErlane, $28,183.20; George H. Meyer, $30,878.65; Henry Frank, $25,231.30; P. Murray & Son, $23,098.85; A. B. Ashman, $25,866.

Lincoln Ave.: Folz & Jonte, $14,735; M. Peter & Son, $11,951.05; Dan'l Minihan, $11,453.65; W. C. Murray, $14,-531.01; Henkel & Brehm, $11,703.25; George H. Meyer, $15,-789.20; B. Strack, $18,382.30; P. Murray & Son, $11,646.39; Henry McErlane, $15,005.75; H. Frank, $10,813.50.

Muncie, Ind.—The contract for the outlet sewer has been let to T. W. Kinser at $90,000, or $9 per ft.; it will be a brick sewer 44 x 84 ins.

Detroit, Mich.— Contracts have been let for the sewers, for which $260,000 bonds have been issued. The contracts are as follows: Woodward Ave., T. L. Campau, $14.49 per ft.; Geo. S. Langley, $12.97; Vinewood Ave., $3.13 and $2.89; Junction Ave., John Appeld, $2.43 and $4.43; John Wagner, $4.87 and $4.19. McDougall Ave, $3.80; Helen Ave., Geo. S. Langley, $3.38. Beauport Ave., Geo. S. Langley, $3.49.

Grading.—Jones Bros., of Sioux Falls, Dak., have been awarded the contract by the Northern Land Co. for grading the site of the new town of Garretson, on the Sioux City & Northern Ry. There will be about 100,000 cu. yds. of earth excavation.

Brush Dykes.—The following proposals for the construction of 5,800 ft. of brush dykes in the James River, Va., were opened Oct. 8, by Col. WM. P. CRAIGHILL, U. S. Engineer Office, Richmond, Va.: Wm. T. Gaynor, Fayetteville, N. Y., $1.50 for style A, $1.50 for style B, $1.50 for style C, $1.70 for style D. J. F. Bradley, Manchester, Va., $2.39, $1.89, $1.29, $3.39. C. Powell Noland, Richmond, Va., $3.75, $1.95, $1.90, $4.99. Styles A, B and C are for pile dykes, Style D is for places where piles cannot be driven to hold. The specifications for this work are given elsewhere.

New York Paving.—The Board of Public Works recently awarded 11 contracts for street paving with granite blocks on concrete foundation; of these contracts, Charles Guidet had seven, amounting to $187,459, James Pollock had three, amounting to $60,728, and Thomas Gearty had one, at $178,190. Mr. Guidet's prices were $3.21 to $3.56 per sq. yd. for pavement, 49 cts. per ft. for bridge stone for crosswalks, and $4.50 per cu. yd. for concrete. Mr. Pollock's prices were $3.65 to $3.72 for pavement, 55 cts. for bridge stone, $4 for concrete. The engineer's estimates were based on $3.50 for paving, 50 cts. for bridge stone and $5 for concrete.

Street Work.—*Albany, N. Y.*—The contract for improving Mohawk St. has been awarded to Jacob Holler at 18 cts. per cu. yd. for excavation and 9 cts. for filling. The contract for grading and cobblestone paving on Hawk St. has been awarded to Thomas Reilly, Jr., at $1.10 per yd. for paving, 60 cts. for new curb, and 10 cts. for relaying old curb.

Kansas City, Mo.—The Board of Public Works has awarded contracts as follows: Paving on Windsor Ave., D. G. and D. J. McBean, at $1.41 per sq. yd.; cedar block paving on 6th St., G. J. Baer, 92 cts. per sq. yd.; asphalt paving on Baltimore Ave., Barber Asphalt Co., $2.80 per sq. yd.; paving 8th St., Kepley & Arnent, $3,05 per sq. yd.

San Francisco, Cal.—The following proposals have been received for bituminous rock paving on Kearney St.: Santa Cruz Bituminous Rock & Paving Co., $3,700; Pacific Paving Co., $5,950; Southern California Bituminous Paving Co., $6,618.18.

Sewer Materials.—*Baltimore, Md.*—Contracts have been awarded by the mayor, comptroller and register for furnishing materials for the Wolfe St. sewer as follows: Stone, John G. Schwind at $1.70 per cu. yd.; hand-made brick, Smith & Schwarz at $7.40 per 1,000; sewer blocks, Guilford & Watersville Granite Co. at $111 per 1,000; sand, James P. McGovern at 78½ cts. per cu. yd. Also for the Eutaw St. and Fremont St. sewer to the following persons: Lumber, P. M. Womble at $24.95 per 1,000 ft.; sewer blocks, Guilford & Watersville Granite Co. at $166 per 1,000; sand, M. Deivil at 60 cts. per cu. yd.; piles, J. S. Hoskins at 6¼ cts. per lin. ft.; hand-made brick, Carroll Brick Co. at $7.45 per 1,000; machine-made brick, James R. Busey & Son at $7.70 per 1,000; stone, David Leonard at $1.90 per cu. yd.

Wharf.—At Tacoma, Wash., the contract for the building of the large wharf to extend from the deep-water mark in the Sound near the tide lands, on the east side, to the Ruyallup River, has been let by the Commencement Bay Land & Improvement Co. to Burgess & Rutherford, at $2.28 per lin. ft. The new wharf will cost about $30,000.

Natural Gas Plant.—Proposals for furnishing pipe and fittings have been received by the Natural Gas Trustees, Toledo, O., from the following firms: For pipe, Detroit Pipe & Foundry Co.; Morris, Tasker & Co., Philadelphia, Pa.; National Tube Works, McKeesport, Pa.; R. D. Wood & Co., Philadelphia; Oil Well Supply Co., Pittsburg; American Tube & Iron Co., Middletown, Pa., and Youngstown, O.; Chester Pipe & Tube Co., Harrisburg, Pa.; Schickle, Harrison & Howard Co., St. Louis; Addyston Pipe & Steel Co., Cincinnati; Ohio Pipe Co., Columbus; Wells Rustless Iron Co., New York; Lake Shore Foundry, Cleveland, O.:

For fittings: Shaw, Kendall & Co., Toledo; R. D. Wood & Co., Philadelphia; H. B. Milmine & Co., Toledo; Jarecki Mfg. Co., Erie, Pa.; Galvin Valve & Hydrant Co., Detroit, Mich.; A. W. S. Carr & Co., New York; Brass & Iron Works Co., Fostoria, O.; Chapman Valve Mfg. Co., Chicago; Oil Well Supply Co., Pittsburg, Pa.; Builders' Iron Foundry, Providence, R. I.; Union Foundry & Machine Co., Pittsburg; Atwood & McCaffery, Pittsburg, Pa.

The concrete foundations of the new building for the Central Railroad of New Jersey, foot of Liberty St. New York, in the specifications called for "the best Portland cement procurable." Tests made resulted in the employment of Gibbs' Portland cement, known as the "Diamond brand" and imported by Mr. HOWARD FLEMING, 23 Liberty St., New York, who we are advised is furnishing a large contract for the Chignecto Marine Railway.

Asphalt Paving.—The bids for the paving of Madison Ave. 32d and 33d St., 36th and 41st, 42d and 48th Sts., and 58th St. between Madison and Fifth Ave. were opened Oct. 14, by Commissioner GILROY. The Sicilian Asphalt Co. bid the lowest, the total figure being $121,000. The Taylor Co. bid $134,250. On the contracts for paving of Park Ave. between 34th and 40th St., the bids were also opened. The Barber Asphalt Co.'s bid of $44,100 was the lowest.

The estimates made by the lowest bidders on both these pavements were much higher than the estimates of the department's engineers, but their figuring was predicated on the idea that the guarantees were for five years, whereas on these contracts the guarantees are for fifteen years, the contractor to get 70 per cent. of his money thirty days after the completion of the work, 30 per cent. at the end of six years, and 3 per cent. annually for the remainder of the time which the guarantee runs.

PROPOSALS OPEN.

Sewers and Paving.—No. 1: 610 lin. ft. of 44 x 50-in. and 75 ft. of 42-in. brick sewer; 700 ft. of 12-in. pipe, 11 manholes, 1 special manhole, 2 basins, 1,200 cu. yds. rock excavation, 5 cu. yds. concrete, 700 ft. B. M. lumber. No. 2: 6,800 sq. yds. of trap block pavement. No. 3: 1,000 cu. yds. earth and 50 cu. yds. rock excavation, 2,350 cu. yds. of filling, 3,150 ft. of curbing, 11,200 sq. ft of flagging, 3,150 sq. ft. of bridge stones. No. 4: 25,000 sq. ft. of rock asphalt pavement, 7,800 sq. ft. of concrete pavement. THE PARKS COMMISSIONERS, 41-51 Chambers St., New York City. Oct. 23.

Street Work.—Repaving and crosswalks. THE COMMISSIONERS OF PUBLIC WORKS, 31 Chambers St., New York City. Oct. 23.

Levee Work.—About 200,000 cu. yds. on Ward Lake levee, 25,000 cu. yds. of excavation in Hushpuckana Bayou, and 80,000 ft. B. M. of cypress plank wall; all in Coahoma County.—T. G. DABNEY, Chief Engineer, Levee Board Office, Clarksdale, Miss. Oct. 25.

Dredging.—About 70,000 cu. yds. at Black Rock harbor and channel, Erie County. JAMES SHANAHAN, Superintendent of Public Works, Albany, N. Y. Oct. 25.

Sewer Materials.— For Pulaski St. sewer. A. M. SMYRK, City Commissioner, Baltimore, Md. Oct. 25.

Gas Well.—Sinking a well 2,000 ft. Rock is encountered at a depth of 60 ft. or less. Bids to include price per foot for the first 1,000 ft. and per foot for each additional 50 ft. Work to be commenced at once. DOANE & Co., 619 Paxton Building, Omaha, Neb. Oct. 25.

Excavation.— About 25,000 cu yds. mud or muck, 96,000 cu. yds., sand or gravel, 3,000 cu. yds. loam. JOHN A. COLEMAN, Commissioner of Public Works. Providence, R. I. Oct. 30.

Road Work—Improving present wagon road and building new road between Keno, Ore., and the State line, near the Klamath River, Engineer P. G. EASTWICK has prepared plans and specifications. CHAS. S. MOORE, Chairman, Klamath River Wagon Road, Linkville, Ore. Nov. 1.

Building.—Materials and labor for foundations and brickwork, labor for setting masonry and iron work for the completion of the extension to the State House. Architects, Brigham & Spofford, 27 Mt. Vernon St., THE STATE HOUSE COMMISSIONERS, 27 Mt. Vernon St. Boston, Mass. Nov. 4.

Bridge.—Iron bridge over the Chattahoochee River. JOHN T. COOPER, Clerk of Committee on Roads, Atlanta, Ga. Nov. 6.

Bridge.—Iron or wooden bridge across Falling River; 149 ft. span. S. H. HUDNALL, Brookneal, Va. Nov. 9.

Bridge.—Stone substructure; iron and wood superstructure. THE COUNTY COMMISSIONERS, Columbus, O. Nov. 9.

Building.—Conant library building. Architect, J. M. CURRIER, 345 Main St., Springfield, Mass. THE CONANT LIBRARY BUILDING COMMITTEE, Winchester, N. H. Nov. 30.

Brick Paving.—About 5 squares. THE CITY CLERK, Wellsburg, W. Va.

Asphalt Paving.—The only contract received by Col. O. H. ERNST, at the Office of Public Buildings and Grounds, Washington, D. C., for constructing an asphalt paving at the new Army Medical Museum, was from H. L. CRANFORD, of Washington, at $2 per sq. yd.

MANUFACTURING AND TECHNICAL.

Cars.—The St. Charles Car Works, of St. Charles, Mo., have built 17 passenger cars for the Union Pacific, and are building 12 passenger cars, 4 baggage cars, and 4 mail cars for the same road.

The Lake Shore & Michigan Southern has given an order for 350 coal cars to the Lafayette Car Works, of Lafayette, Ind. The railway has also contracted for 300 coal cars, 300 box cars, and 300 gondolas.

The St. Louis Car Co., of St. Louis, Mo., has increased its facilities and can turn out over 600 cars a year. Some street railway cars are being manufactured for Japan. President, D. MCALLISTER; Secretary, JULIUS LEFFMAN; General Manager, P. M. KLING.

The Ohio Falls Car Co., of Jeffersonville, Ind., is building cars for the New Orleans, Fort Jackson & Grand Isle.

The Roanoke Machine Works, of Roanoke, Va., have an order for 300 cars for the New York, Lake Erie & Western.

The Kansas City Car Works, of Kansas City, Mo., are building 100 refrigerator cars for the Chicago, Milwaukee & St. Paul.

Ties.—The Denver & Rio Grande R. R. Co. has awarded to George P. Jones a contract to furnish 250,000 standard gauge ties. The work will be confined to the neighborhood of Salida and will employ 250 men. This contract is considered as conclusive evidence that the company intends widening the road from Cañon City to Grand Junction.

The West End Electric Ry. Co., of Boston, has awarded to James H. Oak, of Presque Isle, Me., a contract for 20,-000 hackmatack ties.

Diving Apparatus, Etc.—A. J. Morse & Co., of Boston, Mass., supply improved apparatus and supplies for submarine work, including air pumps, helmets, and diving suits, etc. The firm also manufacture improved nozzles and other fire protection apparatus.

Storage Batteries.—M. JULIEN, the inventor of the electric storage battery system now in use on the electric cars of the Fourth Ave. line in New York, has been awarded a gold medal for his exhibit at the Paris Exposition.

Pneumatic Block System.—The Union Switch & Signal Co., of Swissvale, Pa., has a contract to equip the Jersey Central Ry., between Jersey City and Bergen Point, with the pneumatic block system of interlocking switch and signal apparatus.

Steel Ties.—The Standard Metal Tie & Construction Co., of New York, has its hydraulic plant erected at the Carnegie Works, at Pittsburg, and has commenced manufacture. The machinery was built by the Scarife Foundry & Machine Co., of Pittsburg. The ties are of channel section, pressed to shape from steel plates, and have a block of compressed, creosoted wood, on end grain, under each rail. The ties are to be tried on the Chicago & Western Indiana Ry.

Locomotives.—The McQueen Locomotive Works, of Schenectady, N. Y., have built 22 engines for the East Tennessee, Virginia & Georgia. There will be 7 passenger engines, with 68-in. drivers, and 18 x 24-in. cylinders; 13 consolidation engines and 2 switch engines.

The Jersey Central has recently added 25 new locomotives to its rolling stock.

The 10 new engines which the Big Four has ordered will be adapted for hauling passenger trains or fast live stock or freight trains. They will be 10-wheel engines, having three pairs of drivers 63 ins. in diameter, 19 x 24-in. cylinders, and will weigh without the tender, 124,000 lbs. The tenders will weigh an additional 66,000 lbs., and will hold 3,500 galls. of water. The ordinary tenders hold but 2,400 galls.

The Baldwin Locomotive Works have an order in hand for 14 engines for the Lehigh Valley.

The Pond Engineering Co. is furnishing 3 boilers of 50 H. P. for Kansas City complete with standard rocking grates, etc. The company is supplying the Vine St. Electric Ry., whose power plant it put in, with belting and a Tracy oil filter and the Security Building, Kansas City, with the Pond Engineering Co.'s feed pump and receiver. The 750,000 gall. pumping engine for Taylorville, Ill., has been erected.

The Bucyrus Foundry & Mfg. Co, of Bucyrus, O., one of the largest and best known firms of builders of steam excavating machinery in the United States, is very busy, running day and night. Last year the company added $12,000 worth of heavy tools to the plant, built a

new erecting shop for heavy works, 180 x 45 ft., fitted with overhead traveling cranes and all modern improvements, and sold and shipped 48 steam shovels and 16 dredges, many of them very large machines, besides a number of railway wrecking cars and other machinery of various kinds. This firm has excellent facilities for turning out work of the best grade.

Locomotive Wanted.—O. P. PELL, 47 Liberty St., New York City, wants a 10-ton engine, 42-in. gauge, for the San Domingo Shore Ry.

Snow Plough.—The Juil Mfg. Co., of Brooklyn, N. Y., has an order for one of its snow excavators from the Pennsylvania Railroad Co., which is now in course of construction at the Rogers Locomotive & Machine Works, Paterson, N. J.

Railway Material Wanted.—Prices for flat rails and double-end cars for a street railway. Address P. O. Box 44, Beaumont, Tex.

Locomotives, cars, railway supplies, and wooden railway bridges. J. P. KENNERLY, Charleston, S. C.

The Babcock & Wilcox Water-Tube Steam Boiler was awarded the *Grand Prix* and the *Diplome d'Honneur* at the Paris Exposition, the highest award given to any exhibitor. This award was not in the list noticed lately in this journal, as it was given to a boiler made in their Glasgow shops and placed in the British sections. No less was to be expected, however, for a boiler which, by its own merits and the energy of its makers, has made necessary by far the largest boiler-making plant of its kind in the world.

Cement.—The Western Portland Cement Co., of Milwaukee, Wis., will build a branch railway to its works. President, WM. PLANKINTON; Secretary, JOHN JOHNSTON.

Spikes.—The Hercules Spike Co. has been organized at Chicago, Ill., by H. G. BICKWELL, JAMES WHYTE and H. L. NORTON. Capital stock, $300,000.

Iron Works.—The Southern Iron Co. has been organized at Huntsville, Ala., with a capital stock of $10,000,000. The charter requires one of the offices to be there. The deal is one of the most important in this section for years, and embraces the consolidation of the Lagrange, Ætna and Warren Furnace Cos., the Boone Iron Co., of Chattanooga, and the Wayne County Iron Co. Six furnaces now in operation are involved in the deal, and many thousand acres of fine ore lands in Hickman, Stewart and Wayne Counties in Tennessee, and several Alabama furnaces. The main object is to manufacture charcoal, iron, and steel on a large scale. Among the prominent actors in the deal are: A. M. SHOOK, G. M. FOGG, NAT. BAXTER, Jr., T. M. STEGER, W. E. MCNEILEY, C. E. CURRY, ED. BAXTER, PERCY WARNER, JOHN P. WILLIAMS, and I. S. RHEA, of Nashville, and H. S. CHAMBERLAIN, of Chattanooga, who organized under a charter obtained by SAMUEL H. BUCK, of Huntsville, from the last Alabama Legislature, and who participated in the organization. T. T. HULLMAN, of Birmingham, JOHN H. INMAN and C. M. MCGEE, of Knoxville, are also interested. NAT BAXTER, Jr., will be President, and A. M. SHOOK, General Manager.

The Pond Engineering Co., is furnishing the Model Laundry of Kansas City, Mo., with a 150 H. P. Hoppes live steam purifier with which it is proposed to get the boilers entirely free from scale. The company is putting in at the Eastman Hotel, Hot Springs, Ark., one of the largest size Pond feed pumps and receivers. They furnished two of the same size to the Liggett & Meyer Building St. Louis, Mo., a short time ago. Large orders for Sheffield grate bars are reported.

Tippett & Wood, of Phillipsburg, N. J., have issued an illustrated catalogue of water towers, stand-pipes, boilers, iron railway turntables, etc. They also make bridges, roofs, tanks, heaters, stacks, riveted pipe, blast furnace and mill work, etc.

BRIDGES AND CANALS.

Bridge Notes.—*North Kingstown, R. I.*—The Hamilton Ave. bridge will be a truss bridge 105 ft. span, with a 20 ft. roadway and 2 sidewalks each 5 ft. wide. The Phœnix Bridge Co. has the contract for the superstructure, and James Cook, of Lafayette, for the abutments.

Albany, N. Y.—The New York Central and the Boston & Albany railway companies will build the highway bridge over the tracks at East Albany, as recommended by the Railroad Commissioners. It will be 1,200 ft. long, crossing 18 tracks, and will cost $75,000.

Trenton, N. J.—The last Legislature passed a bill authorizing ALFRED M. PARSONS, WM. G. HOWELL, A. L. WORTHINGTON, and others, to build a free bridge over the Delaware River.

Baltimore, Md.—The contract for the masonry of the Cedar Ave. Bridge has been awarded to Jones & Thorne, at $14 per cu. yd. for the abutments and $19.50 for the piers.

Fort Spring, Md.—The contract for the bridge over the Greenbrier River has been awarded to the Pittsburg Bridge Co., for the superstructure, and Huddleston & Richards for the masonry.

Wheeling, W. Va.—Baird Bros., contractors for the Union railway bridge over the Ohio River, will begin work soon.

Columbia, Tenn.—The contract for masonry for the Duck River Bridge has been awarded to Holmes & Wilkes, of Nashville, at $5,606.87.

Charleston, S. C.—J. P. KENNERLY invites correspondence from builders of wooden railway bridges.

Jacksonville, Fla.—The second span of the new iron bridge has been placed.

Keokuk, Ia.—A high bridge is projected. Bids will be issued for $100,000. Capitalists will furnish $25,000 and the city will subscribe $25,000.

Denver, Col.—A temporary bridge is to be built to replace the old bridge at Larimer St. until the new permanent bridge is built.

Little Rock, Ark.—A project is on foot to build a highway bridge across the Arkansas River at the foot of Main St. It will be 1,500 ft. long, and will have a draw span. The cost will be about $200,000. For particulars address Mr. F. J. H. RICKON, City Engineer.

Bridges and Culverts.—The County Commissioners, Cincinnati, O., have awarded contracts as follows: Bridge masonry and fill over Muddy Creek, on Wisher road, Green Township, to Nick Ruebel, for $1,035.60; Underpinning abutment and repairing riprap at first bridge on Camargo pike, Columbia Township, to J. L. Kenath, for $170.45. Repair of bridge on German road, Springfield Township, W. L. Jones, $40.46. Semi-circular arch culvert, drains and fills, Flat Run road, between Allandale and Camp Dennison, to Val Zind at $888.50. A resolution was adopted that the Engineer be directed to prepare and submit a plan to the Board for the construction of an iron superstructure on the Mostetter road crossing, Mill Creek, and inspect the abutments. The Commissioners also unanimously awarded the contract of inspecting the iron work of the Colerain Ave. bridge to G. W. G. Ferris & Co., of Pittsburg, at $2,935.

New York State Canals and Bridges.—The following contracts have been awarded by JAMES SHANAHAN, Superintendent of Public Works, Albany, N. Y.: The proposed improvement to the Champlain Canal was divided into eight sections, seven of which were let. The contract for section No. 2 was given to John W. Whelan & Co., Whitehall, at $25,246. The other bidders were: Flood & Riley, Sandy Hill, $29,633.25; Troy Public Works Co., $33,624.—No. 3, to Whalen & Co., at $17,640. Other bidders: Flood & Riley, $18,390.75; Troy Public Works Co., $22,011.50.—No. 4, to James E. Flood & Co., Sandy Hill, at $2,645. Other bidders: Whalen & Co., $2,837; Flood & Riley, $2,823; Troy Public Works Co., $3,200.—No. 5 to James D. Sherrill, Sandy Hill, at $7,684. Other bidders: Wharton & Co., $8,145.80; Flood & Co., $8,105.60; Flood & Riley, $8,760.20; Troy Public Works Co., $10,577.30.—No 6 to Flood & Co., at $2,139. Other bidders, $2,147.50; Flood & Riley, $2,147.50; Troy Public Works Co., $3,016.25; John H. O'Connor, Glen Falls, $2,379. No. 7. to Flood & Co., $1,992. Other bidders: Whalen & Co., $2,238; Daniel Sturtevant, Sandy Hill, $2,506; Flood & Riley, $2,164.30; Troy Public Works Co., $3,708.25. No. 8. Flood & Co., $2,877; Whalen & Co., $3,385; Flood & Riley, $3,319.90; Troy Public Works Co., $3,542.

The contract for building the superstructure of the Main St. Bridge, Fultonville, was awarded to James E. Flood & Co., at $4,233.20.

Wm. Fuller, Rochester, was given the contract for building the Genesee River wall, for which $6,000 was appropriated at $4,283. The other bidders were: James Robinson Rochester, $4,725; Wm. H. Jones & Son, Rochester, $4,925; B. P. Smith, Rochester, $4,312.25; James H. Kelly, Mt. Morris, $5,034.75; Geo. Chambers, Rochester $4,833.25.

Aqueduct.—The canal commissioners have condemned the aqueduct over the Fox River at Ottawa, Ill., and ordered a new one, at a cost of $30,000.

Canal Excavation.—The Board of Directors of the Central Irrigation District, Maxwell, Cal., has received the following proposals for excavation: John Kelso & Co., San Francisco: 26½ cts. per cu. yd. for subdivisions, No. 1, of 60-ft. canal 21 cts., for No. 2, 20 cts., for No. 3. Turton & Knox, Sacramento; 16¾ and 18¼ cts., for No. 2, Grant Bros., Los Angels; 23 cts., for No. 2, 20 cts., for No. 3. San Francisco Bridge Co; the contract was awarded to this company at $17.74 cts. per cu. yd. for the three subdivisions; the total amount will be about $213,000. R. DELAPPE is Secretary of the Board of Directors of the District.

ELECTRICAL.

Electric Lighting.—*Oldtown, Me.*—A Westinghouse plant will be put in and will be operated by water power, furnished by the Bodwell Water Power Co.

Buffalo, N. Y.—The bids of the Brush, Thomson-Houston, and United States companies for lighting streets and buildings for one year were all 42½ cts. per light per night.

Oswego, N. Y.—The city has contracted for 160 street lights at $17,000 per annum.

Cumberland, Md.—A proposition to put in an electric light plant has been made by W. J. JOHNSON, of Middletown, Del.

Harrisonburg, Va.—The proposition made by a Baltimore company to put in an electric light plant will probably be accepted.

Lynchburg, Va.—All the bids have been rejected and new ones will be advertised for. J. D. SULLIVAN is Chairman of the Light Committee.

Florence, S. C.—W. R. BARRINGER has made a proposition to furnish the city with 60 incandescent lights of 30 c. p. for $900 per year, if granted exclusive franchise and exemption from taxation for 25 years.

Tuscaloosa, Ala.—A contract for electric lighting has been made with B. F. RODEN, of Birmingham.

St. John's, Mich.—An electric light company has been organized, with a capital stock of $25,000. President, R. M. STEEL; Vice-President, D. S. FRENCH; Secretary, R. G. STEEL.

St. Charles, Mo.—D. J. BORGMEYER, HENRY SANDFORD, and J. P. MILLER have been appointed a committee to investigate the electric lighting question.

Medford, Ore.—A proposition to put in an electric light plant for Medford and Jacksonville has been made by Mr. CONVERSE.

Grant's Pass, Ore.—An electric light franchise has been awarded to FREDERICK M. JOHNSON, of San Francisco, Cal.

San Mateo, Cal.—The California Electric Light Co., of San Francisco, has made a proposition to put in lights of 2,000 c. p. at $1.10 per light per night.

Bonham, Tex.—The Bonham Electric Light & Power Co. has been organized. President, Dr. B. DARNEY; Treasurer, JOHN RUSSELL. It has a 5 years' contract, and has ordered its plant from the Heisler Electric Light Co., of St. Louis, Mo.

Whitby, Ont.—The Ball Electric Light Co. has a 3 years' contract for street lighting. There will be 20 arc lights.

Toronto, Ont.—It is proposed to put the electric light wires underground.

SEWERAGE AND MUNICIPAL.

Sewers.—*Lynn, Mass.*—The contract for building the continuation of the western intercepting sewer has been awarded to George Jepson at $37,297.

South Framingham, Mass.—On Oct. 11 a town meeting accepted and adopted the report of the special sewerage committee, turning the system over to the town, and elected as a sewerage committee JOHN H. GOODELL for three years, P. HAYES, Jr., two years, R. M. FRENCH, one year from next March. The town appropriated $6,000 to finish and operate the system.

Providence, R. I.—The city will spend about $8,000,000 in improvements to the sewerage system.

Albany, N. Y.—The Committee of Thirteen, in the report on the water supply question, suggest the construction of an intercepting sewer to carry the sewage to a point below the city, to avoid the present contamination of the water opposite the city.

Trenton, Ga.—A sewerage system is projected. For particulars address the Town Commissioners.

Gadsden, Ala.—The contract for the construction of a sewerage system has been awarded to George L. Gillespie, of Chattanooga, Tenn.

Duluth, Minn.—The following bids were received for the sewer in 1st alley: Lundgren & Johnson, $2,709.60; Bubar, Pattison & Sang, $2,806.50; Fowler & Caughell, $2,859.40; Edward Fitzgerald, $3,086.60.

St. Paul, Minn.—The Board of Public Works has awarded the contract for a sewer on Delos St. to James Hansen at $1,227.

New York City.—Commissioner GILROY, of the Department of Public Works, has sent in the estimate of his department for 1890. The aggregate is $3,080,925, an excess over the sum allowed last year of $285,589.61. Of the increase $130,200 is needed for aqueduct purposes in enlarging the reservoir in Central Park, and removing a gateway in 9th Ave. Another item of the increase is $142,285.65 for repaving streets.

Montreal, Can.—At a recent meeting of the City Improvement Association, the Secretary in his report referred to the unsanitary condition of Point St. Charles, and recommended that this state of things be inquired into. Another matter to which attention should be given was the proposed voting of $1,000,000 in connection with the harbor front. This report was adopted, and it was resolved that a committee, consisting of Mr. DELISLE and the chairman, should be appointed to inquire into and obtain information regarding the investment of the $1,000,000.

New Orleans, La.—Plans and proposals for a sanitary system of privies, and the best method of removing and disposing of fœcal matter, are wanted by C. P. WILKINSON, M. D., President of the Board of Health, 63 Carondelet St.

WATER-WORKS.

NEW ENGLAND.

Portland Me.—The new reservoir is nearly completed.

Old Town, Me.—The question of constructing works is being considered. F. H. CLERGUE, of Bangor, has made arrangements with the Bodwell Water Power Co. to furnish a supply, if sufficient encouragement is given by the town.

Pittsford, Vt.—Works are projected. Address the City Clerk.

Readsboro, Vt.—A contract for constructing a $10,000 system of works has been awarded.

East Boston, Mass.—An 8-in. main is being laid on Morris St.

Attleboro, Mass. — Mains are now being laid to connect with the Old Colony R. R. Co.'s new tank.

Provincetown, Mass.—We have received the following information:

When works are constructed water will probably be pumped from driven gang-wells to a stand-pipe. Preliminary surveys have been made by PERCY M. BLAKE, of Hyde Park. Estimated cost, $65,000. An act passed the legislative session of 1889 granting the town permission to construct works, but no further action has been taken by the town.

Needham, Mass.—At a special town meeting to vote upon the adoption of the legislative act authorizing the town to construct works, 146 votes were cast for, and 117 against, its adoption. A two-thirds vote was necessary.

Boston Mass.—The committee on water has presented an order to take by eminent domain, if necessary, all land, etc., required for the extension, improvement andcompletion of the city's works, and authorizing the city treasurer to borrow $1,045,000, the bonds to bear 4 per cent. interest, and payable Oct. 1, 1919. From the loan, $775,000 to be expended for constructing basin No. 5; $170,000 for purchasing Whitehall pond and all water rights and mill privileges, and $100,000 for purchasing Cedar swamp and purifying its waters.

Warehouse Point, Conn.—The new works have been completed, and will soon be put in operation.

MIDDLE.

Amsterdam, N. Y.—A small amount of mains are now being laid.

Islip, L. I., N. Y.—We have received the following information from WM. F. LECLUSE, of Sayville, L. I.:

The town of Islip has contracted with the Great South Bay Water Co. for 23 miles of mains and 200 hydrants, at $6,000 per year, for fire protection only. Private consumers are to make their own terms with the company. Water will be pumped, probably from driven wells, to a stand-pipe. Construction is to be begun about Nov. 1, and completed before 1891. Estimated cost, $300,000. JOHN LOCKWOOD, President. Population, 9,000.

Rouse's Point, N. Y.—Bids will be received on Nov. 1 for $24,000, of 20 year 6 per cent. bonds, by WILLIAM TURNER, Secretary.

Westfield, N. Y.—Work has been temporarily suspended.

Coxsackie, N. Y.—Meetings are being held by the Board of Trade to consider the question of constructing works.

Medina, N. Y.—The town has adopted resolutions providing for complete works. Bids for their construction will at once be advertised for. Dr. MUNSON and Pres. HILL are interested.

Newark, N. J.—The following resolutions have been adopted: Provided that three engineers be appointed to decide upon the material to be used for the pipe lines; one to be provided by the Aqueduct Board, one by the water company, and one called as consulting engineer. Also that the Mayor and Common Council elect and determine to terminate that part of the contract made by the Newark Aqueduct Board and the Mayor and the Common Council of the city of Newark with the Lehigh Valley Railroad Co. and the East Jersey Water Co. for a new water supply for the city of Newark, dated Sept. 24, 1880; further to become the purchaser under the said contract of the water and water rights to be conveyed as in said contract set forth, and of the works to be constructed as therein agreed, this election being made in pursuance of the provisions of said contract; also that the Newark Aqueduct Board be requested at once to take similar action, and the City Council directed to give the proper notice of this determination as soon as said Board shall have passed the proper resolution.

Pottstown, Pa.—The Board of Managers of the Gas & Water Co. have purchased 12 acres of land on a bluff west of the town on which they propose erecting a large reservoir and pumping station. This will enable them to secure the supply from the river above the town.

Montrose, Pa.—A company has been incorporated to build works. Capital stock, $30,000.

East Stroudsburg, Pa.—The town has voted to build and own its works, and will soon issue $15,000 of 4 per cent. bonds for that purpose.

Pine Grove, Pa.—The following information is from AARON F. FELTY:

The town will issue bonds for the works which will probably be constructed by the Pine Grove Water Co. No contracts have been awarded. Water will be pumped from Black Creek to a stand-pipe. Population, 1,500.

Kingston, Pa.—C. W. BOONE, City Clerk, sends us the following:

A gravity system of works, will probably be constructed by a private company. Estimated cost, $300,000 to $400,000. Information can be obtained from A. NESBITT. Population 2,500.

Philadelphia, Pa.—An ordinance has been published, authorizing the laying of a considerable amount of additional mains.

Bradford, Pa.—Engineers, J. NELSON TUBBS, of Rochester, N. Y., and Mr. STURTEVANT, of Wilkesbarre, Pa., have been chosen arbitrators to decide the questions at issue between the city and the contractors who constructed the city's works. About $35,000 is involved.

Oil City, Pa.—A high-service system is to be constructed on South Hill. A new main is to be laid from the reservoir across the river, to supply the north side of the city. Estimated cost of improvements, $10,000.

Baltimore, Md.—The large main to be used for distributing the water from the new Guilford Reservoir has been laid on the York road as far as Waverly. It is reported that Chief Engineer MARTIN expects to complete the work this fall.

Cambridge, Md.—M. W. J. JOHNSON, of Middletown, Del., has made a proposition to build the works. A proposition has also been received from CHAS. F. DIETRICK, of Baltimore.

Georgetown, D. C.—The bid of the Phoenix Bridge Co., of Phoenixville, Pa., for constructing the iron truss over Rock Creek to support the new 40-in. water main has been accepted.

SOUTHERN.

Clifton Forge, Va.— It is reported that G. Bargamin, of Staunton, has contracted to build the new works. A 300,000-gall. reservoir will be constructed, 2½ miles of 6-in. pipe laid, and 15 hydrants set.

West Lynchburg, Va.— A reservoir is to be constructed by the Lynchburg Land Co.

Charleston, W. Va.— The company is laying a new main across Elk River.

Moundsville, W. Va.—The question of constructing works is again being agitated. A majority of the City Council favor the proposition and many of the citizens demand that the Council proceed in the matter at once.

Point Pleasant, W. Va.— The subject of building works is being agitated. Address the City Clerk.

Blowing Rock, N. C.—Address J. M. BERNHARDT, of Lenon, N. C., for information regarding a projected system of small works for this place.

Fayetteville, N. C.—J. T. DENNY wishes to correspond with water-works contractors.

Greensboro, N. C.—The company has reorganized, and will improve its works.

Henderson, N. C.—It is reported that W. H. BOSLEY of Baltimore, Md., will probably organize a stock company and construct works.

Columbia, S. C.— Additional mains will be laid by the Columbia Land & Improvement Co.

Anderson, S. C.—Works will probably be constructed. Address the Mayor.

Valdosta, Ga.—Works are to be established, and material will probably soon be wanted. Address W. L. THOMAS.

Trenton, Ga.—A company is being organized to build works. Address J. P. BOND.

Newnan, Ga.—R. F. MILNER sends us the following:

The proposed works, if constructed at all, will be built by a private company. The town charter forbids their construction at public expense.

Monticello, Fla.— G. S. VAN BUSKIRK informs us that the subject of building works is now being considered.

Atalla, Ala.—Works are projected.

Florence, Ala.—The Jeter & Boardman Water & Gas Association, of Macon, has awarded the contract for constructing a foundation, and erecting a stand-pipe, for the new works, to McCussin Bros. & Thomas, of Birmingham.

Johnson City, Tenn.—Address the mayor for information regarding the projected works.

Nashville, Tenn.—The contract for laying the 36-in. main has been awarded to Thomas J. Pease. Contract price, $16,273.60.—The new reservoir has been completed, and will soon be officially tested, together with the new mains and Holly-Gaskill pumping engine. The cost of nstructing the reservoir was $500,000.

Gallatin, Tenn.— Works are projected. [Works to cost $10,000 to $15,000 were talked of in 1888; the town proposing to issue bonds. Water was to be pumped from wells.—ED.]

Tullahoma, Tenn. — The question of constructing works is again being agitated. [Prospecting was done in 1888, with a view to pumping the supply from two springs to a reservoir; 10 miles of mains were proposed. Estimated cost, $25,000. GEO. W. DAVIDSON was then interested.—ED.]

Newbern, Tenn.—S. PARKS sends us the following:

The Newbern Corporation is making arrangements for the erection of works.

City Engineer HARRY A. EVANS, of Stanford, Ky., has kindly sent us information regarding the following places:

Stanford, Ky.—Preparations are being made to construct works. Address HARRY A. EVANS.

Harrodsburg, Ky.—Arrangements were made with a company to build works, but the project was defeated by a large vote, taken, to ratify the contract.

Richmond, Ky.—Works are projected.

Nicholasville, Ky.— The town has a good well, and wants some party to put in a pump, to be run by a windmill, and supply water by direct pressure.

Paris, Ky.—Nothing definite has been decided upon nor is it likely anything will be done soon.

Georgetown, Ky.—Works have been completed.

Bowling Green, Ky.—A stand-pipe is to be erected.

Lebanon, Ky.— The 250,000-gall. masonry reservoir will be completed in December. The Scovel & Irwin Construction Co., of Nashville, are the contractors. Superintendent, JOHN RUBEL.

Newport, Ky.—U. S. Barracks.—The contract for constructing the new stand-pipe and tower will probably be awarded to P. Murray & Sons, of Cincinnati, O., they being the lowest bidders.

Louisville, Ky.— Additional pumping machinery is being added.

NORTH CENTRAL.

Toronto, O.— Works are to be constructed. J. D. COOK, of Toledo, O., is the Engineer.

Lima, O.—The New York, Lake Erie & Western R. R. Co. is building an additional reservoir at their main shops for the purpose of supplying their engines and the shops with water.

Upper Sandusky, O.—A water tower, 100 ft. high, is to be erected.

London, O.—F. W. MILLER has sent us the following information:

Works are to be constructed. Estimated cost, $100,000. Work will be begun about Nov. 1. Water will be pumped from artesian wells to a stand-pipe. The contract for complete works has been awarded to JOHN P. MARTIN, of Xenia, O. Population, 4,000.

Fostoria, O.— A report recommending a pumping system of works has been presented to the City Council by J. M. HOWELL, and adopted. Plans and specifications are now being prepared. The supply will be taken from the east fork of Portage Creek, which has a drainage area of about 17 sq. miles. Two reservoirs of 35,000,000 galls. and 100,000,000 galls. respectively, will be constructed; also a tower having a capacity of about 300,000 galls. Two independent sets of pumping machinery, each of 1,500,000 galls. capacity, will be provided, and 16 miles of 14 to 4-in. mains laid.

Huntington, Ind.—Bids for constructing works will not be received on Nov. 1 as previously advertised, the matter having been indefinitely postponed.

Wolcottville, Ind.—It is reported that works are to be constructed by the Wolcottville Water Co.

Madison, Ind.—The town has decided to construct works, and has appointed the following gentlemen a committee to take the preliminary steps: J. A. WEBB, J. P. ALBRIGHT, J. S. PAULMER, DANIEL BURNS, J. M. TUNIS, ENOS WILDER, and JEREMIAH BAKER.

Peru, Ind.—Rigid investigations of the purity of the water now being used by the city are being made by the City Council.

Dowagiac, Mich.— The new works have been completed, and will soon be officially tested.

Allegan, Mich.—Popular vote has defeated the proposed purchase of a new engine.

Negaunee, Mich.—Prof. VAUGHAN, of Lansing, Chemist of the State Board of Health, has analyzed samples of water from Teal Lake and Jackson Spring, which are the only sources of water supply in the city, and states that they are the worst specimens of water ever submitted to him for analysis. Steps will probably be taken to purify the water.

Fenton, Mich.—It is reported that works costing $25,000 are to be constructed. [We repeat this note to correct a typographical error in our issue of Oct. 5.—ED.]

Gladstone, Mich.—The new works have been satisfactorily tested. Keating & Sheehan, of Detroit, were the contractors.

Portland, Mich.—The Portland Water Co. has been incorporated. Capital stock, $30,000.

Murphysboro, Ill.—It is reported that works are projected. [The record of this place in THE MANUAL OF AMERICAN WATER-WORKS for 1888 stated that Gray Bros., of Milwaukee, were sinking an experimental well. It is probable, therefore, that works are being constructed instead of projected. The Estimated cost was $30,000.—ED.]

Ottawa, Ill.—A new aqueduct is to be constructed. Estimated cost, $30,000.

Union Grove, Wis.—The artesian well, 2,000 ft. deep, which has been furnishing a plentiful supply, is reported to be drying up.

Richland Center, Wis.—A system of works costing $20,000 has been established. The reservoir is 125 ft. above the town. There are 5 miles of mains.

Washburn, Wis.—The new works are being constructed by Moffett, Hodgkins & Clarke, of Watertown, N. Y. R. C. PEARSONS is Constructing Engineer. There will be 4 miles of mains, and 50 hydrants. Materials have probably been ordered.

Oshkosh, Wis.—A new water tower is to be constructed. Estimated cost, $8,000.

Brodhead, Wis.—Works are projected.

NORTHWESTERN.

New Castle, Ia.—The artesian well is down 600 ft., with no signs of water.

Dawson, Ia. — Works are projected. Address G. GROTT.

Emmettsburg, Ia.—The new works will cost about $10,000.

Manchester, Ia.—The question of building works has recently been voted upon.

Council Bluff, Ia. —Complaints are being made of the impurity of the water.

Jefferson, Ia.—A scarcity of water is reported.

Sibley, Ia.—We have received the following information from M. J. CAMPBELL:

The subject of constructing works is now being discussed, but nothing definite has been decided upon. The supply will probably be taken from wells.

Sioux Rapids, Ia.—The following information has been received from JAS. M. HOSKINS, Mayor:

The original contractors have forfeited their certified check, and all contracts will be relet in January or February, 1890. Water will be pumped from a large well to a reservoir. Estimated cost, $10,000; $5,000 to be raised by issuing bonds, the remainder by taxation. Engineer, J. A. MITCHELL, of Cedar Rapids. Population, 1,000.

New Hampton, Ia. — L. L. BRIGGS has sent us the following:

The town is seeking an experienced company, with capital, to establish works. A project for the town to erect a system of works, costing $8,000, was defeated last spring.

Minneapolis, Minn.—The new pumps at the North Minneapolis pumping station have been put in operation.

St. Paul, Minn.—Petitions for a considerable amount of extensions have been received.—Work on the new main to connect with the Rice lakes is nearly completed, and the 10,000,000-gall. pumps will be put in operation about Nov. 15.

Anoka, Minn.—We have received the following from J. C. FROST:

The Anoka Water-Works, Electric Light & Power Co. has awarded the contract for complete works to E. T. Sykes & Co., of Minneapolis. The works will be completed about Dec. 15. The supply will be pumped from the river to a stand-pipe. Estimated cost, $50,000. President, E. T. SYKES; Secretary, JESSE CHASE. Engineer, T. M. RYAN. Population, 8,000.

Plainview, Minn.—The town is considering the water problem for fire protection.

New Ulm, Minn.—The following is from LOUIS SHILLING:

The supply is to be pumped from deep wells to a reservoir, thence to a tower. Contract price, $10,900; procured by town bonds. Fairbanks, Morse & Co., of St. Paul, are the contractors. Work is to be completed June 1, 1890.

Little Falls, Minn.—The City Council has granted a franchise to W. M. FULLER and S. STOLL to build and operate a complete system of works. The city is to pay $2,400 per year for 35 hydrants.

Girard, Kan.—The following information has been received from JAMES S. JAMES:

The city wants works, and will grant a franchise to a reliable company on favorable terms. Three franchises have already been granted, but all have been forfeited. About 6½ miles of pipe, and 52 hydrants would be needed. Population, 3,500.

Topeka, Kan.—A petition has been presented to the City Council by the Topeka Water Supply Co., for permission to extend their mains and put in additional hydrants.

Leavenworth, Kan.—Geiger & Campbell have been awarded the contract for the excavation and stone work for a new reservoir, 300 by 400 ft., and 24 ft. deep.

Hooper, Neb.—We have received the following from M. LYMAN:

Contracts for complete works will be let about Oct. 25. Estimated cost, $10,000. Water will be pumped to a reservoir. Population, 700.

Wymore, Neb.—A. A. RICHARDSON, of Lincoln, Neb., has been engaged to prepare plans and specifications for a complete system of works. A vote will soon be taken on the question of issuing $30,000 of bonds.

Fremont, Neb.—Additional and larger mains are being laid.

South Omaha, Neb.—A petition has been received asking for additional hydrants.

New Castle, Neb.— Kilpatrick Bros. are to construct works. Estimated cost, $20,000.

Kearney, Neb.—It is reported that new mains are to be laid, and a considerable number of hydrants set. [These works were built and are now owned and controlled by the American Water-Works & Guarantee Co., Ltd., of Pittsburg, Pa. W. S. KUHN, General Manager.—ED.]

Watertown, Dak.—S. A. Kean & Co., 115 Broadway, New York City, are now offering $121,000 of 6 per cent. year bonds for sale.

Helena, Mont.—The City Engineer has been instructed to investigate the Lump gulch project again, and report to the City Council.

SOUTHWESTERN.

Webb City, Mo.—Articles of incorporation of the Webb City Water-Works Co., have been filed in the Recorder's office, at Carthage, Mo. The stockholders are JAMES O'NEALE, E. T. WEBB, and J. W. AYLOR. Capital stock, $80,000.

Eureka Springs, Ark.—The question of building works is being discussed, and will probably be decided soon. It is proposed to grant a franchise to a private company.

Morgan, Tex.—We have received the following information from JAMES MOORHEAD, of Waco, Tex:

The contract for works to be completed about Jan. 1, 1890, has been awarded to JAMES MOORHEAD, o Waco. Work is to be begun about Nov. 1.

Dallas, Tex.—The following bids for lining two storage and subsiding reservoirs have been received by the City Engineer: Fred Wing & Co., Dallas, Tex., concrete in bottom, per cu. yd., $6.50; gravel, including placing same on slopes, per cu. yd., $4; brick furnished and paving; per sq. yd., $1.75; Laing & Smoot, of Dallas, furnishing materials and completing work, $89,000; Grant Bros. & Wilderhold, Pottsville, Pa., work complete, $99,840; H. L. Breneman, Parish, Tex., concrete in bottom, per cu. yd., $7.40; gravel, including same on slope, per cu. yd., $8; brick furnished and paving, per sq. yd., 90 cts.; work complete, $117,854; Keystone Paving Co., Pittsburg, Pa., concrete in bottom per cu. yd., 70 cts.; brick furnished and paving per sq. yd., $1.80; work complete, $113,500. The contract has been awarded to Laing & Smoot.

Siloam Springs, Col.—Engineer HARMON has completed surveys and estimates for a complete system of works.

Manitou, Col.—Colorado Springs is extending its new 16-in. main. Work will be in progress through the streets of Manitou in a week or ten days.

Holyoke, Col.— A final official test of the new works, has been satisfactorily made.

Beldo, Col.—An order for part of the machinery for the new works has been awarded to P. P. Mamon, of St Louis, Mo.

Barnum, Col.—The Beaver Brook Water Co. has been awarded the contract for furnishing a water supply.

Denver, Col.—The Mountain Water Co. has commenced trenching. Pipe for its new mains has been purchased from the Chattanooga (Tenn.) Foundry and Pipe Works. The Deane Steam Pump Co., of Holyoke, Mass., will furnish two large pumping engines, and two 100 H. P. boilers. F. P. Arbuckle, of Denver, is the contractor. He is also building a large reservoir on Cottage Hill for the Beaver Brook Water Co.

Del Norte, Col.—The artesian well contractors have begun sinking a 6-in. well for the town. They are prepared to go 1,500 ft.

PACIFIC.

Cheney, Wash.—The Cheney Water Co. has been incorporated. Capital stock, $50,000. The trustees are: J. D. SHERWOOD and OSCAR HUBER, of Cheney, and FRANK F. DICKINSON, of New York.

Spokane Falls, Wash.—Sealed proposals will be received on Nov. 5, for furnishing and laying a 12-in. main, about 3,780 ft. long, also a 6-in. main, approximately 1,850 ft. long; also to furnish and lay 160 ft. of 4-in. pipe for hydrants, by J. J. WHITE, City Clerk.

Warwick, Ore.—The Badger Ditch & Water Co. has been incorporated by S. H. DOUGLASS, JAS. PATTISON, and C. E. PRATT. Capital stock, $15,000.

Albany, Ore.—Negotiations are pending for the sale of the Santiam Canal, Magnolia flouring mills and water-works, owned by JOHN A. CRAWFORD, to H. B TURNER, of New York. The value of the property is about $150,000.

East Portland, Ore.—One of the company's reservoirs has been declared unsafe. Steps will probably be taken to strengthen it, or build a new one.

Grant's Pass, Ore.—FREDERICK M. JOHNSON, of San Francisco, has secured a franchise to supply Grant's Pass with water.

Portland, Ore.—T. M. RICHARDSON, W. K. SMITH, and W. S. LADD have been appointed a committee to take the necessary steps to secure the right of way for the pipe line to be laid from Palatine Hill.

San Luis Obispo, Cal.—JNO. A. NOCEK, Superintendent, informs us that one mile of new 8 to 4 in. mains have been proposed for next year

Santa Cruz, Cal.—The City Water Co. has been incorporated by CHARLES H. JACKSON, CHARLES B. LUDWIG, E. R. KING, E. H. RIXFORD, and C. K. BONESTELL, of San Francisco. Capital stock, $500,000.

M. F. STURGES, Civil and Hydraulic Engineer, of Salt Lake City, Utah, has kindly sent us information concerning the four following places:

Nephi, Utah.—The new gravity works will be put in operation in December. They will be owned by the town. An order has recently been placed for 4 or 5 miles of spiral riveted, asphalted, wrought-iron pipe. The 30,000-gall. distributing reservoir is built of redwood. The Engineers are STURGES & BRYANT, of Salt Lake City. Superintendent of construction, PETER SUTTON.

Springville, Utah.—Nothing has probably been done recently.

Salt Lake City, Utah.—The Terrace Heights Addition Co. has given instructions to proceed with the development of their springs, tunnel, and reservoir. Contracts for preliminary grading have been let. Engineers, STURGES & BRYANT.

Pleasant Valley, Utah.—Preliminary examinations have been made by STURGES & BRYANT, and the town has decided to excavate a rock tunnel 3,500 ft. long to tap a lake in the Wasatch Mountains, from which to take its supply.

CANADA.

Montreal, P. Q.— The report of the Superintendent of the Water Department for last year will state that the breast wheel and its three pumps, and the three pumps of No. 3 wheel at the low-level pumping works will need renewing this winter. The tests conducted on the three new Heine safety boilers of 200 H. P. each, and of the new Worthington engine, capacity 10,000,000 imperial galls. were satisfactory.

London, Ont.—Complaints of the quality of the present supply continue to be made.

New Westminster, B. C.— The Coquitlam Water-Works Co. has sold its chartered right to construct and maintain works to the city. A by-law has been voted by the citizens authorizing the city to issue bonds for $200,000 for the purpose of constructing the works. The supply is to be taken from Coquitlam lakes, which are about 14 miles from the city. Bids will soon be wanted. Address the Mayor.

ARTESIAN WELLS.

Raymond, Dak.—The citizens are agitating the question of sinking a well.

Mankato, Minn.—The well at the Mankato Fibreware works has been bored to a depth of about 550 ft., and now flows over 600,000 galls. daily.

Doland, Dak.—A pressure of 150 lbs. per sq. in. is given by a well sunk in this place.

Huron, South Dak.—An Artesian Well Convention has recently been held in this place to discuss plans for sinking wells for irrigating land. Considerable work in this line will probably be done in this section.

Portland, Oregon.—A good flow of water is being obtained from the well sunk for "The Portland" hotel at a depth of 130 ft.

IRRIGATION.

Chicago, Ill.—San Luis Rey Water Co. has been incorporated to acquire by purchase the property rights and franchises of the San Luis Rey Flume Co., a corporation organized and doing business under the laws of the State of California, and to acquire by purchase or other lawful means the waters of the San Luis Rey River, with the right to use and dispose of the same for the purposes of irrigation, shipping, etc. Capital stock, $5,000,000. The incorporators are: EUGENE E. BARNARD, CHARLES L. MORRILL, and WILLIAM H. BABCOCK.

Loup City, Neb.—The Loup City Canal, Water Power & Improvement Co. has been incorporated. Capital stock, $150,000. Address GEORGE W. KITTLE.

Taos, N. M.—Three reservoir sites have been located for the Vermejo irrigation system. One on the Vermejo River and two in the Caliento. M. N. PELS is interested in this project.

Salem, Oregon.—Articles of incorporation have been filed with the Secretary of State for the following companies: The Wallow Water Ditch Co., of Joseph. The incorporators are: PETER BANDON, G. E. GOWING, J. C. WEATHERBY, W. A. MCCULLY, ANTHONY MORGAN, M. SIMMONDS, J. D. MCCULLY, WILL W. WIZWEILER; capital stock, $5,000.—The Prattville Ditch Co., by W. W. PATISON, SAMUEL BROWLES, and A. M. PATISON, of Wasco County. Also the Baisley Elkhorn Mining Co. Capital stock, $195,000. The incorporators are: E. T. HAINES, L. W. NELSON, and R. E. REESE. Portland is to be the principal place of business.

Denver, Col.—The Beaver Farmers' Canal & Ditch Co. has been incorporated by J. M. JONES, DICK SHELTON, and ROBERT TENNANT, of Morgan County. Authorized capital, $5,000.— Also the P. H. Parsons Irrigating Ditch Co., of Morgan County. The incorporators are: P. H. PARSONS, DELIA J. PARSONS, and J. A. GILKERTSON. They have a capital of $10,000, divided into 100 shares.

Modesto, Cal.—E. B. CLARK, President of the Turlock Irrigation District, has sold $500,000 of bonds to San Francisco capitalists. This will be the first company to complete its canals under the Wright bill.

Hollister, Cal.—Work has been begun on the Hollister irrigating canal.

Nampa, Idaho.—A company has been formed for the purpose of taking water from Boise River, near I. N COSTON'S place, about six miles above Boise City. Surveys have been made, and the estimated cost of building the first 10 miles of the ditch is $26,000. The capacity of the ditch will be about 75,000 ins., which will reclaim about 50,000 acres of good land. The plan is to enlarge the Coston ditch and take the supply out of the Boise River.

Anaheim, Cal.—The election to vote on the question of issuing $600,000 of bonds for the new irrigation district resulted in an almost unanimous vote being cast in favor of the bonds. The issuance of bonds insures an excellent water system, bringing into cultivation 20,000 acres of new land.

El Paso, Tex.—The El Paso Irrigation Co. has commenced surveying for their canal. It will extend from Hart's Mill to San Elizario. J. W. BANKS is the engineer. The estimated cost is $75,000.

ANNUAL REPORTS.

We acknowledge the receipt of the following reports:

Connecticut.—Norwich; JUNIUS A. BRAND, Superintendent.

New York.—Clinton; First, Second, Third and Fourth Annual Reports of the Board of Water Commissioners. Courtesy of E. J. WILLIAMS.